TEN YEARS OF ELECTRICAL PROGRESS

OUR DECENNIAL.

Birthday Celebration of the "ELECTRICAL REVIEW," the First Electrical Weekly Published in America.

A Sketch of the History of The "ELECTRICAL REVIEW" and the Electrical Progress of a Decade.

WHAT THE SCIENCE OF ELECTRICITY HAS ACCOMPLISHED IN TEN YEARS.

BUFFALO, HER COMMERCE, INDUSTRIES AND MANUFACTORIES.

The Fifteenth Convention of the National Electric Light Association.

THE PAST, PRESENT AND A LITTLE OF THE FUTURE OF ELECTRICITY.

It is fortunate that newspapers age more rapidly than men. If this were not the case, the celebration of the tenth anniversary of the founding of a journal would partake of the nature of a little boy's birthday party.

As a rule, the first three years of a newspaper's life are the most critical ones. A climax is pretty certain to occur within that time. If the paper is properly supplied with money, properly managed and properly edited, and, above all, if there is a need for it, the climax is rather sure to be an ascending one; but if, on the other hand, any one of these important conditions is of an inferior order, the climax is a rapidly descending one, beside which a toboggan slide is as level ground. With this in view, it may easily be seen that a journal which celebrates its tenth anniversary is really quite old.

That is what the ELECTRICAL REVIEW is attempting to do in this special Decennial Number—celebrate its tenth birthday. As a preliminary to the celebration, it may not be uninteresting to the readers of the ELECTRICAL REVIEW to learn a little of its history during the past decade; the feast of pictures and words will follow this.

THE PAST.

At 23 Park Row, New York, in the *Mail and Express* building, on February 15, 1882, No. 1 of Vol. I of the ELECTRICAL REVIEW made its appearance. It was a little sixteen-page three column sheet, about two-thirds the size of the present paper, and for a few issues was known as the *Review of the Telegraph and Telephone*. There was not an illustration in any of the reading columns; the first article was a poem and the last column was filled with an advertisement of Holmes, Booth & Haydens. Considering the state of the electrical art in those days, the first number of the REVIEW was quite newsy; to be sure, a great deal of this was foreign news because there was not much to talk about here at the time. A good word was put in for the electric light, and it was declared that "it has come to stay." The snow had seriously interfered with the work on the new electric railway at Menlo Park, and this fact was chronicled. And so the news ran on much in this vein. To come down to the business part of it, there were about two pages of advertisements, three of these occupying a page; that is, each of three firms took a column apiece. And it is rather interesting to the present readers and advertisers of the REVIEW to note that every one of the companies which used advertising space in the first issue of the ELECTRICAL REVIEW are still in the paper.

The general run of news and special articles ran along much in the above way until April 15, when the first pictures appeared. These were some diagrams of the harmonic telegraph, and it was stated in the sub-head that the article had been "prepared under the direction of Mr. Gray." In the meantime, the advertising patronage had increased until almost three pages were filled.

In the issue for June 1, wood-cuts first appeared. These were illustrations of some new forms of secondary batteries. In that same issue there was just four pages of advertisements. On March 22, 1883, on which date appeared the ELECTRICAL REVIEW No. 3, Vol. II, the paper was increased to its present size, and the make-up adopted at that time has been generally followed up to the present day. The tone of the journal had gradually developed and increased, patronage had rapidly grown, and the illustrations were of a more modern and acceptable character. From time to time the various improvements and developments of the electrical field were chronicled, all of which are mentioned in a separate article in this Decennial Number.

Up to March 18, 1888, the ELECTRICAL REVIEW had appeared without a cover. At that time the now famous yellow cover was adopted, with a handsome wood-cut design filling the whole first page. The paper was enclosed in this cover until November 21, 1891, when the design on the front page was made smaller, and a good part of the space devoted to the announcements of patrons. The color of the cover remains the same.

Of course, the ELECTRICAL REVIEW has had its vicissitudes, like every other journal, but they have been overcome with reasonable success, and to-day we think we may modestly claim that the ambition expressed in the first editorial, "to make the ELECTRICAL REVIEW the standard electrical publication," has been accomplished.

The development of the REVIEW has been coincident with that of the electrical field, as the journal was started at a time when matters electrical were in a rather chaotic and undeveloped state. It has, doubtless, been a great mutual benefit, both to the electrical industry and the ELECTRICAL REVIEW, to have developed side by side, each helping the other.

THE PRESENT.

The present number of the REVIEW closes the nineteenth volume, and in it we have endeavored to present a reflection of the decade of progress just finished. At the same time we devote considerable space to the National Electric Light Association and to the city of Buffalo, in which it will hold its Fifteenth Convention next week. It has been our endeavor to confine ourselves as closely as possible to the facts to be chronicled, and what our articles may lack in flowery embellishment we have endeavored to make up by our handsome illustrations.

What immediately follows here may be taken rather in the spirit of a *menu* than a table of contents. To begin at the outside, the design on the front cover of this Decennial Number represents in an artistic way the Library Building where the sessions of the Fifteenth Convention of the National Electric Light Association will be held. The Soldiers' Monument, one of the beautiful ornaments of the city of Buffalo, is shown in the foreground. The rest of the design speaks for itself. The frontispiece, which immediately precedes this page, is an artistic effort and goes for what it represents. Immediately following this will be found a descriptive article on the city of Buffalo.

It was a happy selection when the city of Buffalo was chosen as the meeting place of the Fifteenth Convention of the National Electric Light Association. The city has almost limitless advantages as an industrial, manufacturing and shipping center, and in view of the great boon which is to be conferred upon the place by the acquisition of electric power when the Niagara Falls tunnel is completed, it will be well for electrical people to know a little about this great city. You will also find portraits of the officers of the Buffalo Merchants' Exchange, one of the most important commercial organizations in the State, and of several prominent citizens. Several views of points of interest about the city have been incorporated with the descriptive article. Considerable space has also been devoted to the industrial side of Buffalo business life. A number of the large manufacturing establishments are illustrated and described at some length.

And now, if you turn one more page, you will see the portraits—and good ones—of the present officers and executive committee of the National Electric Light Association; on the next page will be found biographical sketches of the electrical careers of these gentlemen. This is, we believe, the first time that a complete series of portraits and biographical sketches of the officers and executive committee of the National Electric Light Association has ever been presented. It is not a small task to secure the pictures and lives of 13 busy men in the electrical field. You will also find some information about the Association and the programme of the meeting to be held next week. A short account is also given of what arrangements Mr. C. O. Baker, Jr., has made for comfortably transporting the delegates to the city of Buffalo.

The special articles which fill a number of columns in this Decennial Number are full of interest. Mr. John A. Barrett, an able and well known electrical engineer of New York, presents a very interesting story which is called "Ten Years With The Telephone." The article is very comprehensive and a great deal of information that is entirely new is contained in it. Mr. William Bracken, the president of the Consolidated Electric Storage Company, which practically controls the storage battery business of the United States, has written an article on "The Storage Battery," which predicts a brilliant future for this device. Mr. Bracken's words are well worth perusal. Mr. J. J. Carty, who is a deep student of scientific matters and a telephone engineer of renown, heads his article with a question, "Is Electricity Related to Nervous Force?" In this contribution a number of interesting questions are asked and some of them are answered. His article is full of meat and will be read with interest and benefit. Mr. George C. Maynard, our Washington correspondent, has given us a comprehensive story on "The Telegraph in America." Mr. Maynard is a member of the Old-Time Telegraphers' Association and was a telegraph operator during the war. He is thoroughly familiar with his subject and writes in a highly entertaining style. Mr. C. M. Morse, of Buffalo, N. Y., an able mechanical engineer, writes an article which is of special interest to central station men. The subject is, "Utilization of Exhaust Steam for Heating Purposes." Mr. Morse has installed a number of such plants and knows of what he speaks. "Germanicus," which is the *nom de plume* of a man you all know, has solved the problem of "Trans-Atlantic Telephony." This is a broad assertion, but—read his story. Mr. Frank A. Perret, a well known inventor, has given a short and interesting account of "The Development of the Electric Motor." "Telegraphic Shorthand" is the title of an article by Mr. John P. Gavit, who is the news editor of the Hartford *Post*. Mr. William H. McKinlock, of Chicago, a prominent electrical dealer and manufacturer, writes a few words on "Electrical Advertising." Geo. A. Hamilton, the able telegraph engineer, gives his views on "The Telegraph and Telephone." Then comes an article of value on "Possibilities of Electric Traction," by Mr. John W. Beane. Scattered in here and there you will find a number of interesting stories about electrical pioneers, biographical sketches, and so on, and finally there is a very interesting and absorbing article entitled, "Footprints of a Decade." This is written by a member of the ELECTRICAL REVIEW's editorial staff, and is intended to mirror in a general way the electrical progress of the past ten years.

THE FUTURE.

The past we are sure of, the present we know about, but as regards the future we can only hope. What the ELECTRICAL REVIEW has done in the past ten years is known to many, and what it is doing in the present you will learn in this Decennial Number. As to what we shall do in the future we can only say that we will endeavor to improve upon the past. Promises are of little value. We prefer to point back to what we have done rather than to tell you what we will do. In this way you may enjoy a surprise and we will make fewer mistakes.

Just at this time the electrical business is getting fairly upon its feet and it seems to us as if the sturdy youth, who may now no longer be referred to as an infant, is about preparing for a leap forward which will be the record jump in the manufacturing and inventive world. It will be the aim of the ELECTRICAL REVIEW to stand by this youth and be prepared to jump and run with him side by side.

BUFFALO.

The Queen City of the Lakes.—A Sketch of the City Where the Fifteenth Convention of the National Electric Light Association Will be Held.

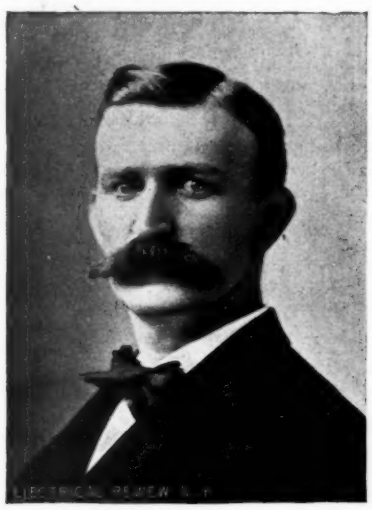
"When the whites first visited this spot they found the Senecas calling it 'Ti-yu-syo-wa,' meaning 'the place of the bass-woods,' the river being lined with these trees for a considerable distance up from its mouth, but the stream itself was designated 'De-gi-yah-goh,' meaning 'Buffalo.' The bison came in large numbers in early Summer to taste the waters and feed upon the abundant rushes of the juicy bottom lands. Buffalo, therefore, the creek was called, and all efforts since have failed to change the name when once attached to the thriving settlement upon its banks."—*Memoirs of T. O. Inhabitant.*

Buffalo, N. Y., the city in which the Fifteenth Convention of the National Electric

JOHN N. SCATCHERD, PRESIDENT BUFFALO MERCHANTS' EXCHANGE, 1891-2.

Light Association will be held next week, is one of the famous places of the United States. It is situated on a plain at the eastern extremity of Lake Erie, at the head of Niagara river, and at the mouth of the Buffalo river. It is a city of 254,457 inhabitants, a port of entry, and the capital of Erie County, N. Y. Buffalo was founded by the Holland Land Company, which owned a large tract of land in Western New York, in 1801. During the war between the United States and England, in 1812, it became a military post, and in 1814 was burned by a force of Indians and British. The village was rebuilt after this war and was incorporated as a city in 1832. Its growth was not rapid until the opening of the Erie Canal in 1825, which gave a great impetus to western emigration, to the settlement and development of the northwest, and to travel and traffic on the great lakes. Buffalo then became the distributing center for the trade between the East and the West. In 1853, Black Rock, a village on the Niagara river, two miles below Buffalo, was incorporated with it.

The City of Buffalo covers an area of 42 square miles, and has been called the "Queen City of the Lakes." It has a water front of three miles on the lake, and of the same extent on Niagara river. Its harbor is formed by the Buffalo river, and is one of the finest on the lakes. The entrance is protected by breakwaters on the north and south sides of the river. The United States Government is engaged in the construction of an outside harbor by building a breakwater designed to be 4,000 feet long. The advantages of Buffalo in a commercial sense are derived from its location at the foot of Lake Erie, which unites with the Hudson river and the seaboard by the Erie Canal, and the centering of many important railroads in its confines. It is also in a most favorable relative position, with many points from which are drawn its receipts of flour, grain, coal, ore, lumber, oil, cattle, hogs, etc. It has the ready means for the distribution of these articles by lake, canal and railroads. It has the benefits of cheap fuel and excellent and abundant water supply, rapid elevating and transfer of grain, quick handling of coal, extensive storage facilities and dockage, with ample harbor accommodations. It is one of the most healthful cities in the United States.

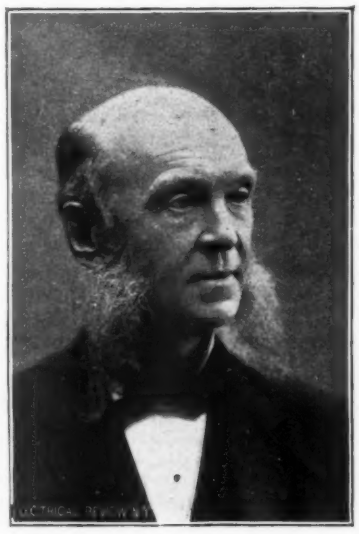


HON. WM. F. SHEEHAN, OF BUFFALO, LIEUTENANT-GOVERNOR OF NEW YORK.

A FEW FACTS.

In view of its present importance to the electrical fraternity, a few figures as to the commerce of Buffalo may not be uninteresting. The receipts of grain, including flour reduced to wheat, by lake, in 1891, were 164,500,000 bushels; lumber, 263,000,000 feet; iron ore, 422,000 tons; flax seed, 6,322,000 bushels; laths, 5,500,000 pieces; shingles, 45,000,000; timber, 41,000,000 cubic feet; wool, 146,000 bales. The receipts of coal during 1891 were about 4,500,000 tons, and the shipments of coal were about 2,436,000 tons. The total shipments of freight by canal during 1891 were 1,186,526 tons, and the receipts of freight by canal were 493,150 tons. The number of boats clearing from Buffalo during 1891 was 6,312. About 8,800,000 bushels of grain, including flax seed, were shipped from the Buffalo elevators during the past year. The custom receipts at Buffalo during 1891 were $832,000. The tonnage of the 321 vessels sailing from the port of Buffalo in 1891 amounted to 164,070 tons.

HON. CHARLES F. BISHOP, MAYOR OF BUFFALO.



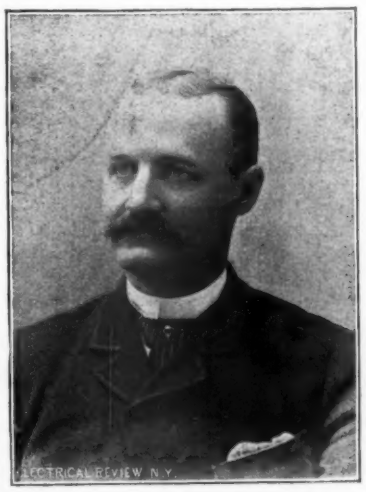
WILLIAM THURSTONE, SECRETARY BUFFALO MERCHANTS' EXCHANGE, 1863-1892.

Items of especial interest about the city are as follows: The water supply is obtained from one reservoir, and two are now being built. About 95,000,000 gallons of water are pumped daily through 341 miles of pipes. There are three gas and four electric light companies, a large mileage of electric railways and four markets. The manufacturing industries of the city include factories for building palace, drawing-room, sleeping and ordinary passenger cars, and freight gondolas and cars. Hydraulic cement of fine quality is manufactured from deposits in the outer wards of the city. About $5,000,000 is invested in breweries, $7,500,000 in malting and about $60,000,000 in manufactures.

Buffalo is said to have more miles of railroad track within its limits than any other city in the world. Twenty-eight railroads center at Buffalo, and when the terminal improvements and additions already planned for these various railroads are completed, there will be about 700 miles of railroad track within the city. The railroads own 3,600 acres of land in Buffalo.

THE BUFFALO MERCHANTS' EXCHANGE.

The Buffalo Board of Trade was constituted in 1844 and incorporated in 1857. It was the commercial institution of the city until January 1, 1884, when the Buffalo Merchants' Exchange, incorporated April 14, 1882, superseded it. The Board of Trade building on West Seneca street is the edifice in which the new organization has since its erection held its meeting, transacted commercial business, and discusses and acts upon matters connected with the welfare of the city, the commerce of the inland lakes, the canals of the State, the railroads, etc. The building has a frontage of 132 feet on Seneca street and 60 feet on Pearl street, and is 100 feet in height, with seven stories, besides the basement, which has a rise of five feet above the sidewalk. There are 73 offices in the building, all pleasant and easy of access. The whole of the fourth floor is designed for the uses of the Merchants' Exchange. The board room is a grand chamber 70 feet long, 53 feet wide and 23 feet high, with a gallery over one end. At each side of the entrance, midway from the east end, telegraph offices are intended to be placed. The entire cost of the land and building complete was in the neighborhood of $250,000. The Merchants' Exchange has 512 members, and owns the controlling stock (3,925 shares) in the Board of Trade building, of the estimated value of $115,950.



CLARENCE W. HAMMOND, TREASURER BUFFALO MERCHANTS' EXCHANGE, 1892.

The officers of the Merchants' Exchange for 1891-1892 are as follows: President, John N. Scatcherd; vice-president, William C. Newman; treasurer, Clarence W. Hammond; secretary, William Thurstone. The portraits of these gentlemen are presented in this issue of the REVIEW. Mr. Thurstone has been secretary of the Merchants' Exchange and Board of Trade since May, 1863.

The present head of the city is Mayor C. F. Bishop, whose portrait appears in another column on this page. The present Lieutenant-Governor of the State, William F. Sheehan, is a citizen of the City of Buffalo, as was also, at one time, ex-president Cleveland.

ADVANTAGES OF THE CITY.

The streets of Buffalo are generally broad, lined with shade trees, and cross each other at right angles. The plan of the city introduces many squares and public places. The private residences are generally neat and tasteful, and include some fine examples of modern architecture. The business portion of the city lies near the lake and river. A system of parks, designed by Frederick Law Olmstead, the architect of the Central Park in New York city, has been laid out. The land taken for park purposes embraces about 550 acres. It is

WM. C. NEWMAN, VICE-PRESIDENT BUFFALO MERCHANTS' EXCHANGE, 1892.

divided into three plots, situated in the western, northern and eastern parts of the city, with broad boulevard connecting, forming a continuous drive of nearly 10 miles. The construction of the parks was begun in 1871.

Among the prominent public buildings are the State Arsenal, the County Penitentiary, the State Armory, the General Hospital, St. Paul's Cathedral, the Erie County Savings Bank, the Buffalo City and the Western Savings Banks. The city is well endowed with educational institutions and a fine system of public schools. The Grosvenor Library is a public library for reference, founded by a bequest of Seth Grosvenor, of New York. It was opened in 1871 and contains about 15,000 volumes, chiefly important books not easy of access elsewhere. The Library Building and Soldiers' Monument are depicted on the handsome cover of this Decennial number of the ELECTRICAL REVIEW.

In the following pages will be found a number of articles, accompanied by illustrations, descriptive of a few of the many industrial features of the city of Buffalo. It may surprise a great many of our readers to learn of the industrial and commercial importance of Buffalo, which, in these two respects, has been rated as the second city in the State.

Ward Arc Lamps in Buffalo.

J. N. Adam & Company, one of the leading dry goods firms of Buffalo, are completing a very handsome new building on Main street. The building is six stories high, 200 feet long, 50 feet wide and rises about 100 feet above the street. One of the features of this building will be the lighting plant.

The boiler plant will consist of two 75 horse-power National water tube boilers. The exhaust steam will be used for heating purposes. There will be two compound non-condensing 60 horse-power engines, built by the Phœnix Iron Works Company, of Meadville, Pa.

The dynamos will be compound wound direct current Mather machines connected in multiple arc to the mains. Each dynamo is to have a capacity of 37,000 watts. The building will be wired for about 200 incandescent lamps.

One of the most important elements of this plant is the use of 90 Ward arc lamps, each taking eight amperes of current at 45 volts. They will be distributed throughout the building as follows: 12 in the basement; 22 on the first floor and 14 on the second, third, fourth and fifth floors, respectively, making 90 lamps in all.

During the past year or two the use of the Ward arc lamp in large wholesale and retail establishments has enjoyed a rapid growth, and it is but natural that the merchants of such a progressive city as Buffalo should follow in the footsteps of their metropolitan brothers. It will be remembered that H. B. Claflin & Company, of New York city, employ about 300 Ward arc lamps in their large store. J. N. Adam & Company have shown good judgment in selecting the Ward arc lamp for interior lighting.

It is claimed that colors and shades may be more readily determined in the light of an arc lamp than in the light from an incandescent lamp or that from a gas burner.

The electrical equipment of J. N. Adam & Company's new store also requires two motors, one to drive a fan for forced air heating, which will probably require from 10 to 15 horse-power, and one to drive a ventilating fan, which will probably require from 5 to 10 horse-power. Taken as a whole, this plant when finished will be one of the most complete isolated installations in Buffalo.

The Duplex Street Railway Track Company, New York.

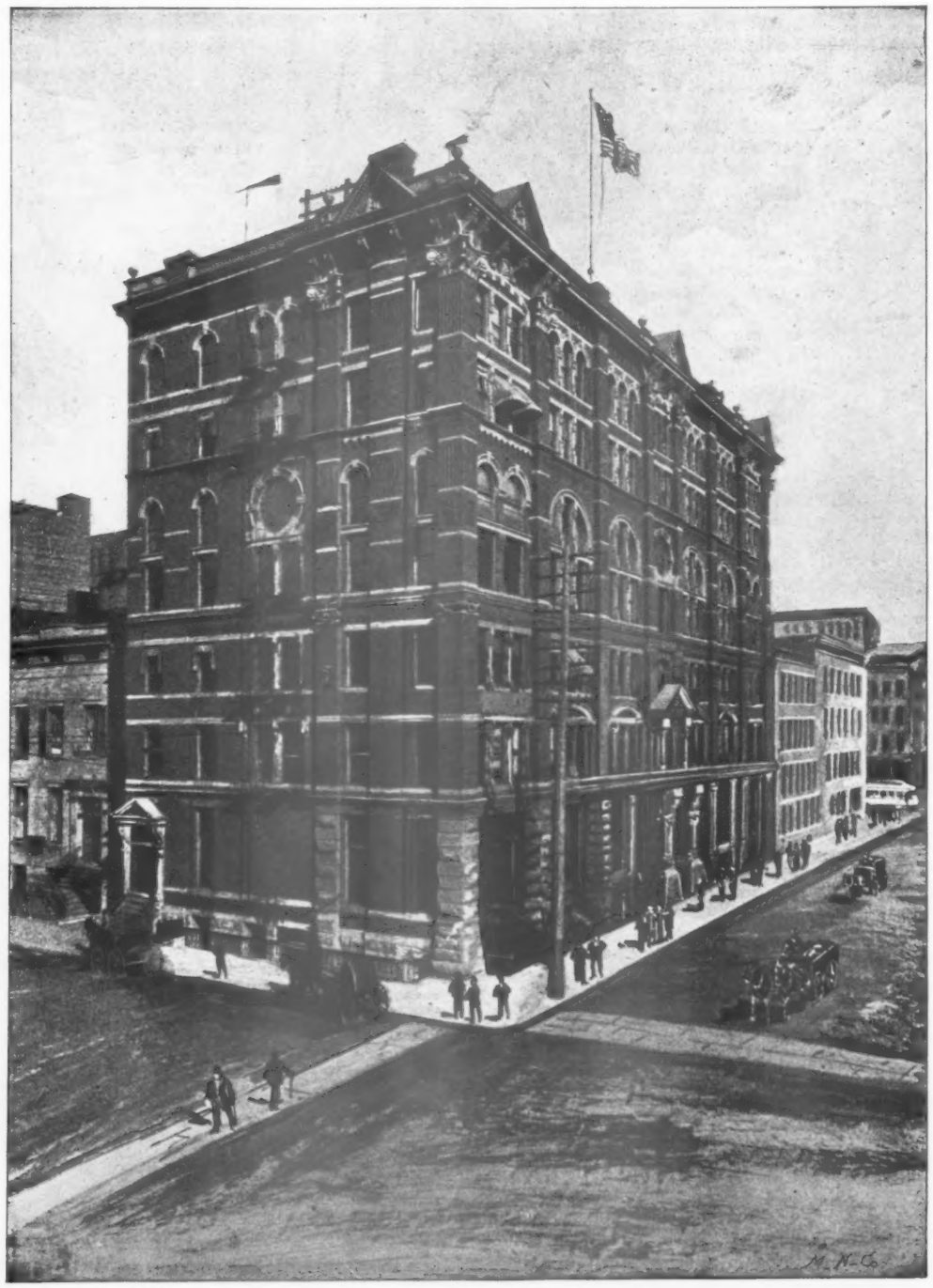
The Duplex Street Railway Track Company, with offices at 51 Wall street, New York city, has made considerable progress recently in the introduction of the Gibbon rail for street railway tracks. The Gibbon patents, which are owned by this company, cover a lap joint construction which makes a smooth riding rail of long life. The system is an all metal one and, therefore, possesses durability and permanence. The rail is built up in sections, so that in renewals only the worn portion is discarded. A large number of prominent engineers have indorsed the Gibbon system, which is especially adapted to electric railway construction, owing to the economy in wiring the tracks.

The Duplex Street Railway Track Company is backed with ample capital for conducting its business, and its affairs are guided by the following board of directors: George Coppell, president, of Maitland, Phelps & Company; Hon. Carl Schurz, vice-president, resident director Hamburg American Packet Company; Wm. H. Male, treasurer, president Atlantic Trust Company; R. L. Edwards, president Bank of New York; Eustace Conway, attorney, 16 Exchange place, New York; Wm. B. Rankine, general manager Niagara Power Company, Mills building; Capt. F. V. Greene, vice-president Barber Asphalt Company; Peter Notman, president Niagara Fire Insurance Company; John D. Elwell, secretary and general manager.

The Pennsylvania Lamp.

A lamp has recently been put upon the market, called the "Pennsylvania," and is certainly making great headway for the short space of time it has been offered to the public. The particular merit of this lamp is not in the appearance or size, but the remarkable results obtained by the manufacturers. The lamps are pumped on a non-mercurial pump, by which not only is a higher vacuum claimed to be produced, but far more uniform results are said to be obtained than it is possible to secure with mercurial pumps. These lamps are free from the vapor of mercury, which, it is claimed, acts injuriously upon the filament and serves to convey minute particles of carbon from the filament to the interior walls of the bulb, thereby blackening it and causing the lamp to burn hot, thus cutting off much of the light emitted. One is impressed with the coolness of the lamps while burning and their freedom from smokiness. The process is purely mechanical and avoids several important disadvantages which other manufacturers find almost impossible to overcome. These fine points, as well as their unusual efficiency, length of life and maintenance of candle-power, which is largely due to the new and improved method of exhaustion, are quite marked, while the glassware and filaments which are used represent a most advanced state of the art. The company manufacturing these lamps is a Philadelphia concern, the Pennsylvania Electric Engineering Company, whose offices are in the Penn Mutual building, and who have a large display of their lamps and other supplies in their extensive show rooms. This company carries a large stock of all voltages, bases and candle-powers and, we believe, has every facility for filling its orders.

This company also makes an anchored filament railway lamp, which is specially constructed to withstand the variations of potential and also the severe mechanical strain to which these lamps are subjected.



THE BUFFALO MERCHANTS' EXCHANGE AND BOARD OF TRADE.

The telegraph line of the Great Northern road, between Seattle, Wash., and North Westminster, was opened for commercial business recently.

The Bishop Gutta Percha Company, New York.

The business of the Bishop Gutta Percha Company was established by Samuel C. Bishop in 1847. Mr. Bishop obtained several patents on the various applications of gutta percha and balata, and up to his death, which occurred July 4, 1872, was very energetic in all matters pertaining to electricity and insulation. He was associated with Morse and Kendal as director of the first telegraph company, and spared no expense in meeting the demands for subaqueous and underground cables, as well as for all the minor grades of insulation in his day. Upon the death of Mr. Bishop, who left all his business and property to his widow, the management of the works devolved mainly upon W. Willoby Marks, who had been Mr. Bishop's superintendent from the beginning. Mr. Marks was not only a natural mechanic with large experience, but thoroughly imbued with Mr. Bishop's business methods, and conducted the business until the formation of the present company in 1885. Mr. Marks had charge of the mechanical work till his death in 1888, having been the head of that department for 40 years.

Mr. W. Walcott Marks, who had from boyhood been his father's assistant, became superintendent upon the death of his father. Two other sons of the elder Mr. Marks, who have spent their time since leaving school constantly at the works, are foremen of different departments. Seven others who were with Mr. Bishop prior to 1872 are still employed at the works.

Mr. Henry A. Reed, the present manager, was first employed in 1878 as an expert to prepare evidence in an anticipated suit with the owners of the Simpson patent. In this work he studied all the patents and processes of insulation then available, and as he had at the same time charge (under Mr. Samuel Boardman, then attorney and after executor of Mrs. Bishop) of the finances, he was, upon the formation of the present company in 1885, made its secretary and business manager.

Up to 1885 the company had depended entirely upon gutta percha and balata for high insulation, but Mr. Reed had become acquainted with insulations which he knew to be their superiors for inside and out-door work, and soon put in complete machinery and obtained from England the best talent for insulating wires, especially for high tension electric light currents, which he then saw was the coming field in electrical insulation. In fact, he felt that the field was already open, although many eminent electricians did not see it.

Since Mr. Bishop's death the managers, although developing many new modes and much special machinery, have not applied for any patents. Their rule is: Machinery, compounds and methods as much as possible to themselves; the results are for the public.

With the best foreign talent assisting Yankee ingenuity of 45 years' development, it is no wonder that the "Bishop" claims to lead in the matter of high insulation.

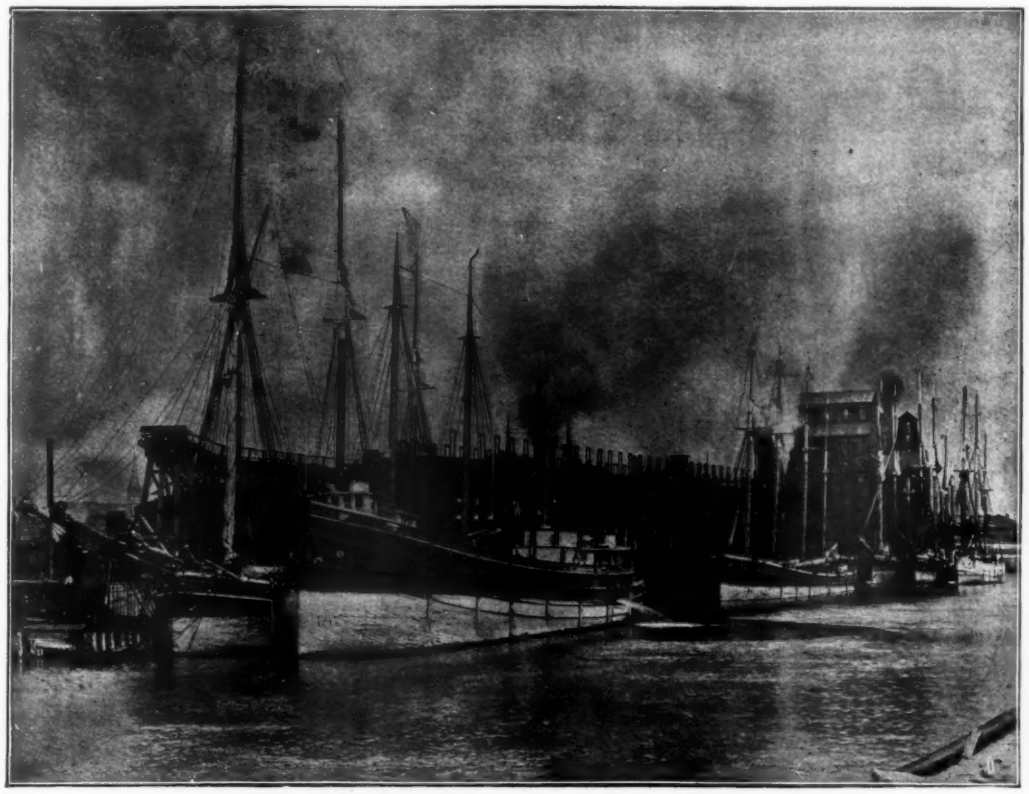
The Hotel Iroquois, Buffalo.

Among the many well-known hotels of Buffalo is the Iroquois. It is one of the largest and finest hotels in the country, and is unquestionably a completely fireproof building. The building covers an area of 20,000 square feet, and has a frontage of 200 feet on Eagle street and 100 feet on Main and Washington streets, respectively. The hotel is eight stories high, and rises to a height of 112 feet above the street. The building is designed in the style of the French renaissance, and is completely modern in all its appointments. The selection of the Hotel Iroquois as the headquarters for the National Electric Light Association was a most fortunate one, and every guest is sure to be well taken care of.

The ladies' parlor, which will be the headquarters of the ELECTRICAL REVIEW during the Convention, is the choicest room in the hotel. It is located on the first floor near the elevator, and opens into the spacious main reception room. The hotel is supplied with the Otis baggage and passenger elevators of modern types.

The Iroquois has an isolated electric lighting plant of its own, consisting of four United States compound dynamos of 550 lights capacity each. These are located in the basement, and are driven by two Rice automatic engines of 110 horse-power each, supplied by the John T. Noye Manufacturing Company, of Buffalo. The fly-wheel of each engine is six feet in diameter with a 24 inch face. There are four 82 horse-power boilers, furnished by Irlbacker & Davis, of Buffalo. Underwood belting is used. Natural gas is burned under the boilers.

Besides supplying current to 2,500 lights in the Hotel Iroquois, this plant serves 300 lights in the library building not far from the hotel. The switchboard is arranged to throw off the lights on half of any floor at any time. The dynamo room is rather small for such a plant, but the apparatus has been very compactly arranged and operates with success. The electroliers and gas fixtures in the house are of tasteful designs, and were supplied by W. H. Glenny, Sons & Company, of Buffalo, as agents for the Mitchell-Vance Company, of New York.



LAKE ERIE GRAIN STEAMERS AT THE BUFFALO DOCKS.

W. H. Glenny, Sons & Company's Establishment, Buffalo.

The firm of W. H. Glenny, Sons & Company was established in 1840, and is one of the oldest crockery houses west of New York city and one of the largest importing houses in their line in the country.

They have occupied their present quarters, a five-story building with a basement and sub-basement, having a frontage on Main street of 55 feet and running through to Washington street, a distance of 200 feet, for the past 20 years, and the immense amount of stock carried by the firm has necessitated the use of another building, of nearly equal size, in the immediate vicinity, as a storehouse for unopened packages.

Since electricity has come so largely in vogue for lighting purposes, the firm has displayed a rich and varied stock of electroliers and have given in their store a practical illustration of the rapid progress made in this line of manufacture from an artistic standpoint.

The main columns are encircled by handsome wrought iron coronals from which are pendant incandescent lamps with opalescent shades, and the iron work of the balconies, which run along either side of the main store and relieve its extreme height, is also formed as to bear, on gracefully curving arms, of large number of electraliers for lighting the space below.

At the back of the store, in the glass department, the electroliers are of cut-glass, while in the silver department the fixtures are of silver with globes of cut-glass.

A large and important branch of the firm's business is the handling of beautiful specialties in silver, glass and bric-a-brac, suitable for presents. They also go very largely into the souvenir spoon business, their goods in this line for Niagara Falls and Buffalo being in large demand.

An idea of the magnitude of their business may be had from the fact that they employ ordinarily 140 men, and during the holiday season the number runs up to 250.

VIEW OF MAIN STREET, BUFFALO.

The Erie County Savings Bank Building, Buffalo.

When completed, the building now being erected by the Erie County Savings Bank in the business center of Buffalo will be the handsomest and most substantial office building in the city, and will compare very favorably with similar structures in New York city. It is an imposing and artistic combination of iron, steel, stone and fireproof tiling, designed in a modern style of architecture by Mr. Geo. F. Post, the well-known New York architect. The building is rapidly nearing completion under the skillful guidance of Mr. C. M. Morse, of Buffalo, the superintending engineer.

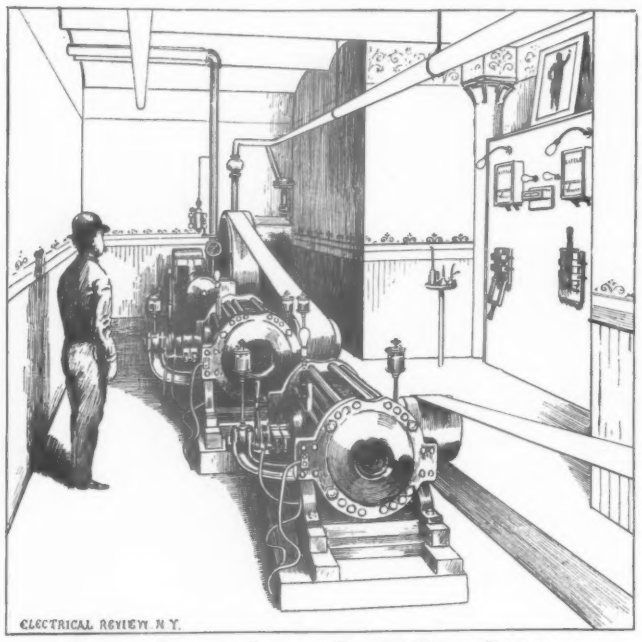
The Erie County Savings Bank building occupies a triangular plot of ground, facing 157 feet on Niagara street, 157 feet on Church street and 147 feet on Pearl street. Such an isolated location is particularly suited to a building of this character.

The cost of the building, when completed, exclusive of the land, will be about $1,000,000. It will be 10 stories high, and will contain about 150 offices as at present designed, besides six large offices in the basement facing Pearl street. The bank will occupy about two-thirds of the first story, which measures 24 feet from floor to ceiling.

The light for the building will be furnished by two 40,000 watt and one 20,000 watt "C. & C." dynamos, driven by two 60 and one 20 horse-power Straight Line engines. Steam will be furnished by four 82 horse-power National water tube boilers. The engines, built by the Straight Line Engine Company, of Syracuse, will be highly finished, and the whole plant will be extremely handsome. The building will be wired for 1,500 lights. Okonite wire will be used throughout. About 50,000 feet of interior conduit, made by the Interior Conduit and Insulation Company, of New York, will be installed.

The main wires from the dynamos to the switchboard will be carried in trenches in the floor. The switchboard will be of slate, and will be equipped with all modern improvements. The lights for the halls, stairways and toilet rooms will be carried on separate circuits, controlled from the switchboard. The electrical work has been undertaken by the American Electrical Supply Company, of Buffalo. The requirements of the specifications are very rigid, and when they have been followed the plant will be a first-class one in every particular.

The Erie County Savings Bank is one of the solid financial institutions of the State. The citizens of Buffalo may well be proud of this new building, which will stand as a monument to the progressive management evidenced by the Erie County Savings Bank and its president, Mr. David M. Morse.



Electric Lighting Plant in Broesel House, Buffalo.

Electric Lighting in Buffalo.

A conference was held recently in Buffalo with relation to reducing the price of street lights. Those present were Public Works Commissioners Field, Mooney and Gatchell, George Urban, president of the Thomson-Houston Company, and James A. Roberts, Franklin D. Locke, Charles A. Sweet and Peter F. Miller, of the same company, Manager C. R. Huntley, of the Brush Company, and his attorney, Frank C. Laughlin. The commissioners held that the price now paid was higher than elsewhere, notwithstanding the reduction to 40 cents, and stated that there was a possibility that the city government might seriously consider the establishment of a municipal electric lighting plant. There was no desire to embarrass the companies, but the price was considered much too high; possibly a three years' contract might be arranged at a satisfactory figure. Mr. Urban stated that the companies were not dividing any money, and that such earnings as had been made had been put back into the plant; nothing had been accumulated that would be considered a good bankable asset. Mr. Locke, who is interested in a company formed to distribute electricity from Niagara in Buffalo, said he had no doubt but that the company would have electric power there by January 1 next. Whilst this was the case, however, expensive machinery would have to be laid aside and the large amounts spent in changing the system at present in use. Mr. Huntley said that the Brush Company had buried $20,000 in conduit work, but that he hoped to have a satisfactory system in use in the Spring. The companies promised to get together and discuss the proposition to reduce the price.

Electric Light Plant in Broesel House, Buffalo.

This plant, while a small one, is very complete in every respect, and the firm of F. P. Little & Company, who furnished and installed the apparatus, are justly proud of the showing it makes and the manner in which every foot of the somewhat limited space allowed them has been utilized.

The plant consists of two Thomson-Houston dynamos, one of 500 and the other of 300 lights, driven by two Rice automatic engines of 50 and 30 horse-power, respectively, coupled in multiple. The engines are from the works of the John T. Noye Manufacturing Company, and are giving excellent service. Steam is supplied by two National water tube boilers of 75 horse-power each.

That the plant, considering its size, is doing good work, may be understood form the fact that there are 790 incandescent and two arc lights in the establishment. The dining-room is very handsomely illuminated, 118 incandescent lights being used in this room alone.

The firm of F. P. Little & Company are among the largest electrical engineering concerns in the city, and have the reputation of doing the finest kind of work. The members of the firm are: F. P. Little, S. F. Eagan and P. P. Miller; and the senior member, having had many years' experience in electrical engineering, is ably fitted to conduct the extensive business of the concern.

They are now engaged on one of the largest contracts ever given out by the State, namely, the fitting out of the western end of the capitol at Albany with incandescent lights, the contract price for the work to be done being $15,000. Aside from their contracting and engineering business they go largely into the handling of electrical supplies of all kinds, and control the agency of the Perkins Lamp Company, the Bryant Electric Company, of Bridgeport, and the Edison-Lalande batteries.

Erie County Savings Bank Building, Buffalo.

The Brush Electric Light Company.

The principal station of this company for arc lighting is located on Maurice and Elk streets in East Buffalo, and is an unusually massive brick structure of rectangular form, divided into three distinct parts by eight-inch partition walls, which separate the engine and boiler-rooms from the dynamo-room.

The entire plant is laid out on a most extensive scale, and a very noticeable feature is the entire absence of any crowding of the machines, which is an element of so much inconvenience and danger in many of our central stations.

The Brush Company are at present lighting from this station an area of about 18 square miles, chiefly in the southeastern district of the city. Scattered over this territory they have 1,200 arc lights on 17 circuits, the average length of which is six miles, giving a total length of over 200 miles of wire.

In the dynamo-room, a view of which is presented herewith, are eighteen 65 light Brush machines, one 70 light Western Electric and one 80 light Wood machine. These are grouped in fours, with the usual regulating devices and ammeters, and are driven from a seven inch line of countershafting, fitted with Hill clutch pulleys, which admits of any machine being stopped or started independently of the others.

Power is at present supplied by a 1,000 horse-power Corliss compound condensing engine, the cylinders of which are 26x52x48 inches, arranged in tandem form, with a 3x18 inch receiver on the high pressure cylinder into which the steam discharges, and after encountering a worm, fed from the main steam-pipe, passes into the low pressure cylinder in a dry condition, thus affecting a considerable saving and doing away with all priming. The cylinders are steam jacketed, and the soft steam from them and from the main steam-pipe is returned to the boilers by means of a Westinghouse steam loop of one and one-quarter inch iron pipe. A jet condenser of 32x12 inch stroke receives the steam from the low pressure cylinder, the power for driving the injection, air, and boiler feed pumps, being derived from the main line of countershafting.

During the past year, to enable them to meet the steadily increasing demand for light, the company have made an extensive addition in the way of a new engine-room, and a 1,500 horse-power engine is now being put in position. When this is in running order, the old engine will be moved from its present position and placed alongside of the new one. The foundations for both engines are completed, and right here a few words regarding these foundations may prove interesting, as they are undoubtedly the most substantial piece of work ever put into a lighting station.

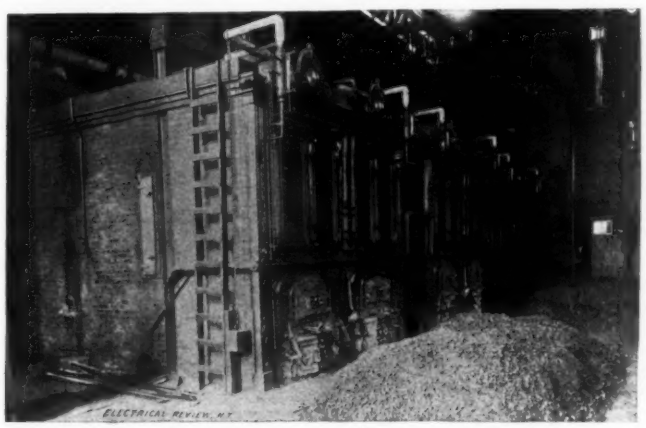


FIG. 1.—BOILER ROOM OF NO. 2 STATION, BRUSH ELECTRIC LIGHT COMPANY, BUFFALO.

On a bedding of two layers of crossed timbers, 12x12 inches, is spread 12 inches of concrete, made from broken stone and Portland cement, and from this the massive piers rise to the level of the floor above, where they are capped with another layer of concrete on which the engines rest. An idea of the size and stability of the foundations may be gathered from the fact that over 1,000,000 hard burnt bricks and 650 barrels of Portland cement were used in their construction, and it is a pretty safe guess that they will stay where they were put for some time to come.

The new engine, which is now almost ready for work, is of the Allis type and is a giant — even among Corliss engines.

It has "twin" cylinders, the diameters of which are 30 to 60 inches, respectively, with a 60 inch stroke. The fly-wheel is 28 feet in diameter with a 76 inch face, and will run at a speed of 65 revolutions per minute. The belt connecting this wheel with the main line of shafting is one of the largest ever made, being 129¼ feet long, six feet wide, and requiring the hides of 240 cattle in its construction. It was made by the Bickford & Francis Belting Company, of Buffalo, and an excellent representation of it, as completed and ready for shipment, will be found elsewhere in our columns.

The boiler-room, a view of which is also given herewith, contains six 200 horse-power boilers of the National water tube type, which are run at a pressure of 130 pounds. Snow duplex pumps supply the water from the Buffalo Creek, which is in the rear of the building, after passing through a Westinghouse steam separator.

Oil is supplied to the main bearings of the engines, dynamos and countershafts from a tank placed at a height sufficient to insure a good head by means of iron pipes, and after passing through is returned to the tank by a small centrifugal pump driven from the main line of shafting, and after passing through a strainer, is again returned to the bearings, thereby giving great economy and efficiency in oiling as well as a material saving in labor.

The switchboard is of the spring-jack pattern and has polarity indicators on each of the 17 circuits, as well as lightning arresters.

Repairing tools and materials are kept on hand, and all repairs to the dynamos are made on the spot by special skilled workmen.

The entire work of construction has been carried out under the designs and supervision of Secretary Charles R. Huntley, who is also general manager of the company, and everything in and about the station shows plainly the results of his liberal and broad-minded policy.

On the west side of town the company have another station from which private arc and incandescent lights are operated and power furnished to isolated plants. This station is interesting historically, from the fact that it was the first to supply alternating currents in this country.

Thirteen 60 horse-power and one 125 horse-power standard Westinghouse engines are in use here, running at from 280 to 320 revolutions per minute, and generating the current by means of Brush 65 light machines for the arc and power circuits, and by Westinghouse alternators of the well-known type, to 5,500 incandescent lamps.

Below the general offices of the company on Washington street, is located the store-room and repairing department, in which all the necessary repairs to lamps, motors, switches, etc., are attended to, the power for the latter being supplied by a two horse-power motor.

Secretary Charles R. Huntley, under whose active management all the numerous innovations and improvements have been made, is one of the best known and most popular men in Buffalo, and from his many years of practical experience in the multitudinous requirements of an electric light plant, will, no doubt, have much that is new and interesting to show to the members of the Electric Light Association at the Convention, in the line of rapid improvements already made in the successful supply of light, heat and power by electricity.

The line shaft, friction clutch pulleys, etc., in Station No. 2, were furnished by the Hill Clutch Works, of Cleveland, Ohio. The original shaft, as first put in, consisted of five pieces, aggregating 104 feet in length, with 16 Hill friction clutch pulleys on same, 72 inch diameter, 13 inch face.

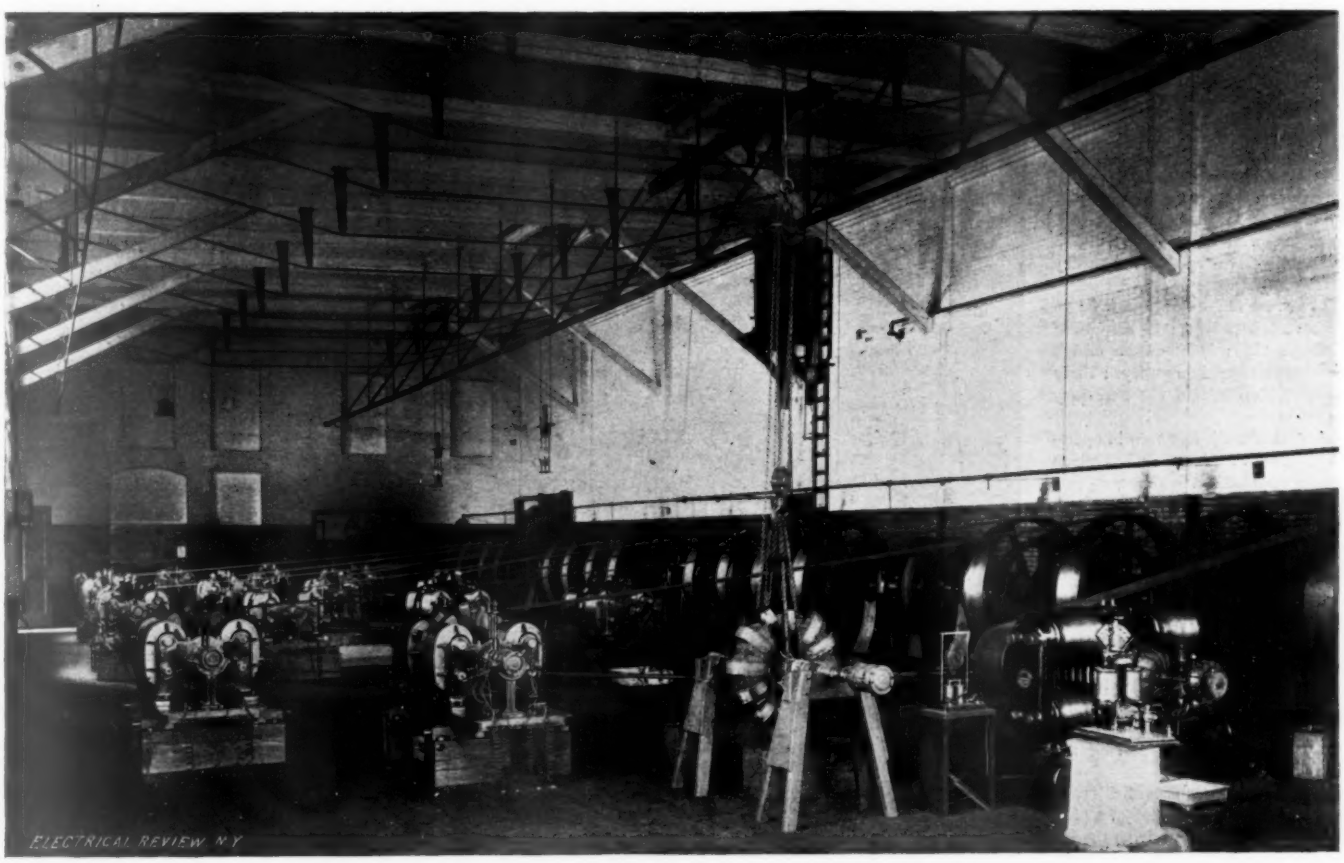


FIG. 2.—DYNAMO ROOM, NO. 2 STATION, BRUSH ELECTRIC LIGHT COMPANY, BUFFALO.

It is supported by 11 self-oiling bearings and stands. The power is received at one end and the belt controlled by one of Hill's patent adjustable belt tighteners.

Last Spring a contract was made with the Hill Clutch Works for an extensive addition to their power plant.

By the new arrangement the power will be transmitted to the shaft from two engines of 800 horse-power and 1,200 horse-power, respectively, instead of one. Either one of these engines can run the entire line of shafting, or they can be run together. By the use of Hill friction clutches either engine can be stopped or started without interfering with the working of the other engine. The belts from these engines are controlled by Hill's vertical belt tighteners.

This new addition to the plant consists of 10 friction clutch pulleys, 72 inch diameter, 13 inch face; one heavy double arm plain pulley, 96 inch diameter, 74 inch face; one 90 inch diameter, 58 inch face, and two 84 inch diameter, 50 inch face.

There are 18 ball and socket self-oiling bearings and adjustable floor stands.

The new line of shafting is 128 feet long, part of it being nine inches in diameter.

The clutch mechanism of each pulley or cut-off coupling is worked by means of a geared operator, which throws the clutch in or out, starting or stopping the pulley or shaft very easily.

They now have 232 feet of shafting; 26 Hill friction clutch pulleys; 29 self-oiling bearings and stands; four friction clutch cut-off couplings; four plain pulleys; three vertical belt tighteners, and the necessary clutch operators.

The original line shaft has been in operation for a number of years and has given most excellent satisfaction.

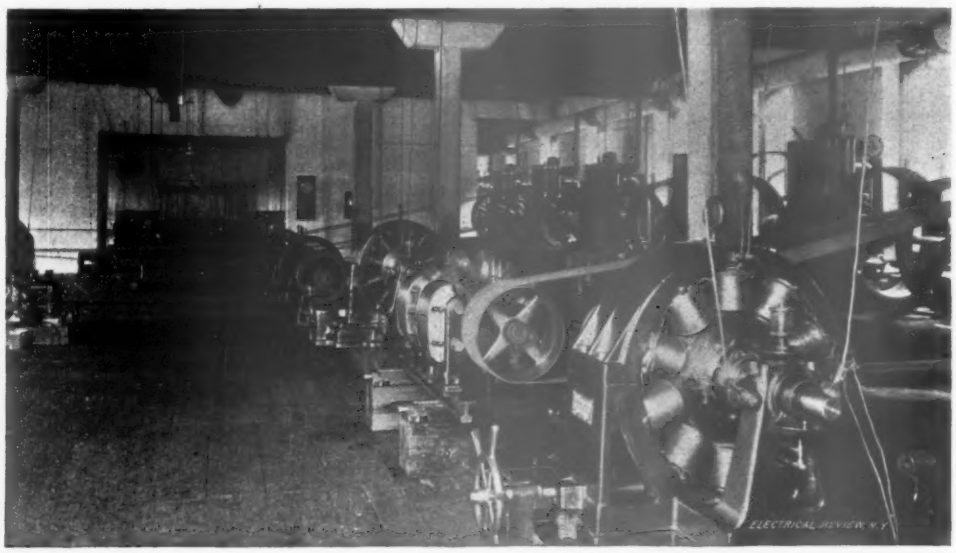


FIG. 3.—DYNAMO ROOM, NO. 1 STATION, BRUSH ELECTRIC LIGHT COMPANY, BUFFALO.

The Buffalo Engineering Company.

One of the prominent engineering firms of Buffalo is the Buffalo Engineering Company, which occupies offices at 228 Pearl street. In 1887 Mr. C. M. Morse, an able mechanical engineer, gave up his business in New York city and opened an office in Buffalo for the practice of his profession. In 1889 Mr. Samuel Ames joined Mr. Morse and under the present firm name they have since conducted a general engineering and contracting business.

One of the latest achievements of this company is the successful installation of a plan for utilizing the exhaust steam from the station of the Thomson-Houston Electric Light Company, of Buffalo, for heating the buildings in the neighborhood. The Barnard vacuum system was used. This company has also installed a large number of satisfactory passenger and freight elevators.

The Buffalo Engineering Company holds a number of important agencies, among them being that for the Otis elevators, both hydraulic and electric, Okonite wire, a number of water tube and other boilers, the Buckeye engines, and the Barnard vacuum system of exhaust steam heating.

The Bell Telephone Company, of Buffalo.

The Bell Telephone Company, of Buffalo, was organized in 1878, and its territory includes seven counties in Western New York. The present officers of the company are Henry M. Watson, president; E. J. Hall, vice-president and general manager; Harlow C. Palmer, secretary and treasurer and Dr. J. N. Culbertson, general superintendent.

The methods of operating the telephone exchange at Buffalo are, in some respects, unique, and a short account of them may not be without interest.

In the first place the use of the metallic circuit telephone has made great strides and has met with entire favor in Buffalo. The advantages of the metallic circuit over the grounded circuit, especially where the air is full of electric light and power and trolley wires, are already well known. Suffice it to say that the officers of the Buffalo exchange have so well presented the advantages of the metallic circuit, and their subscribers have so readily responded to their efforts, that at the present time all of the Company's toll lines throughout the seven counties in Western New York are metallic circuited, and over 75 per cent. of all the subscribers' telephones in the city of Buffalo are now on metallic circuits. It is encouraging to note that the citizens of Buffalo have not taken the narrow ground that the telephone company desires to get more money out of its subscribers by installing metallic circuits, but each subscriber seems to realize that in paying the increased rental for that system he is receiving full value for all additional expense.

The business of the Bell Telephone Company, of Buffalo, is conducted on a toll basis. The yearly rate for an ordinary wall telephone set connected by metallic circuit wires within one-half mile of the exchange is based on the number of messages sent per month. The rates vary from $70 a year, with a privilege of sending 500 messages a month, to $130 a year, with the privilege of sending 1,000 messages a month. Messages in excess of these numbers are charged for at rates varying from $6 to $2 per 100 for the excess. This arrangement seems to meet with the entire approval of the subscribers, and the company is enabled to keep at all times a true record and history of each subscriber and each message sent and connection made.

The telephone business in Buffalo is dependent, to a large extent, upon the season of the year. During the Summer time, when the lake and canal trade is at its maximum, one subscriber is known to have paid for 1,500 calls in one month. The same subscriber, during the month of February, when the lake trade was dull, only used his telephone three times. There are a number of telephones on docks and piers which are fastened up in closed offices and remain unused for two or three months at a time.

Referring to the operating department of this plant, the battery room is equipped with 80 cells of battery, and there are 24 power generators for the operators' calls. These power generators are driven by a Davis safety automatic engine of one horse-power. Natural gas is used for fuel. The engine is run from 7 A. M. to 10 P. M., after which hour the operators call by hand. There are about 2,100 subscribers connected with the exchange, and 75 per cent. of these have metallic circuits. There are about 35 miles of cable now underground. The working force of the operating room consists of 35 girls, who answer on an average 9,000 calls per day.

The method of work pursued in the operating room is rather unique, and possesses many advantages, both for the subscriber and for the exchange. Each girl works eight and one-half hours per day, and the average pay is nearly $7 per week. The salary of each operator depends entirely on her own efforts, as a complete record, in accordance with a strict system of rules, is kept of her daily work. Each operator is allowed 24 days vacation during the year. The working day in the operating room is divided into two portions by the noon hour. When the operators arrive at the exchange in the morning they do not know to what operating table they will be assigned for the morning's work. These assignments are made just before the day's work begins, and are so arranged by the chief operator so as to equalize the work as much as possible. The same plan is pursued when the operators return for the afternoon work. One of the chief advantages of this system is that in case of sickness any operator in the room is familiar with any part of the switchboard, and can be immediately assigned to take the place of the absent one. It also stops favoritism in answering subscribers' calls, and the Christmas present evil has been almost entirely subdued by this means. At one time the Christmas presents for the operators used to arrive at the exchange in wagon loads. Mr. Marvin, the chief operator of the Buffalo exchange, is entitled to the credit for devising this scheme of division of labor.

Taken as a whole, the exchange of the Bell Telephone Company, of Buffalo, is a model in many ways, and the citizens of Buffalo are to be congratulated on the excellent service they receive.

OPERATING ROOM OF THE BELL TELEPHONE COMPANY, OF BUFFALO.

Arc Light Station of the United States Electric Light Company.

This station, the interior of which is shown in our illustration, is located at Black Rock, a suburb of Buffalo, and from here 60 miles of pole lines are operated. The building is of brick, 50x100 feet, and one story high. It is built in the plainest and most substantial manner and is probably one of the cheapest and best paying plants of its size in the country; at any rate this is the opinion of the stockholders, and they ought to know.

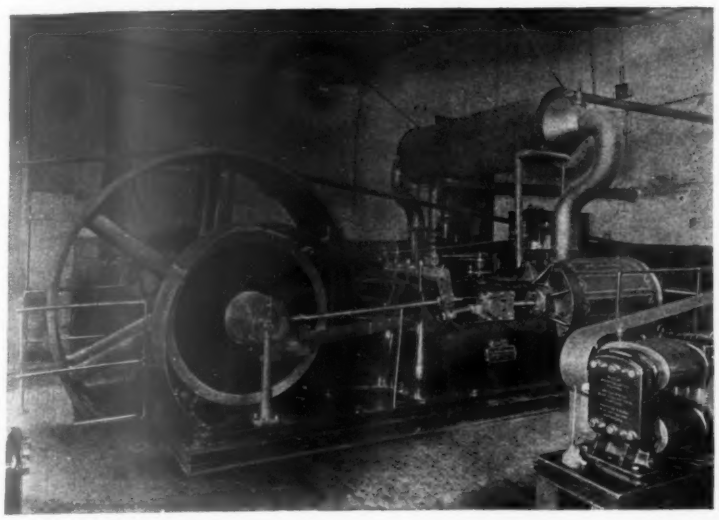


FIG. 1.—JOHN T. NOYE MANUFACTURING COMPANY'S ENGINE AT THE UNITED STATES ELECTRIC LIGHT COMPANY'S PLANT, BLACK ROCK, BUFFALO, N. Y.

There are two lines of five-inch forged steel shafting, each 38 feet long, one on either side of the building, and to these shafts are connected five 60 light and two 20 light United States arc dynamos, and three 60 light new Wood dynamos made by the Fort Wayne Electric Company.

Power is furnished by a pair of Rice compound condensing engines, developing 360 horse-power. These engines, a good illustration of which is given herewith, are built by the John T. Noye Manufacturing Company, of Buffalo. The cylinders are 14x28x30 inches and the driving-wheel has a diameter of 10 feet with a 24-inch face.

The boiler-room, which occupies a space 50x50 feet and is separated from the dynamo-room by a solid brick wall, contains four tubular boilers 5x18 feet, fitted with four-inch tubes. They rest on stone foundations, are bricked in, and connected in pairs with two 40-inch smoke-stacks of No. 10 iron. They are of 80 horse-power each and are fed by natural gas at an average pressure of 120 pounds.

Here, also, is located an independent condenser through which the exhaust steam is condensed by means of a jet of cold water in the hot well, and pumped from there to an open heater, where it reaches almost the boiling point before going into the boilers.

Thomson-Houston Arc Light Station.

This plant, which is operated by the Thomson-Houston Electric Light Company, of Buffalo, is located on Court street within half a block of Main, and occupies a two-story brick building 100x40 feet.

In addition to the large lighting business carried on here, the company is building up a very remunerative steam heating business. By means of the Barnard Vacuum System the exhaust steam from the boilers is utilized and circulated at atmospheric pressure without any additional tax on the boilers themselves, and by this means the company are now heating several large buildings in the vicinity and are contemplating the establishment of a large central heating station in connection with their present plant.

Every available foot of the floor space is covered with machinery, there being located here 14 arc light dynamos ranging from 50 to 65 lights each; 2 Thomson-Houston 1,500 light alternators; 1 Thomson-Houston 650 light alternator; 1 Thomson-Houston 400 light incandescent machines and 1 Thomson-Houston 362 light generator of 100 horse-power for power circuits.

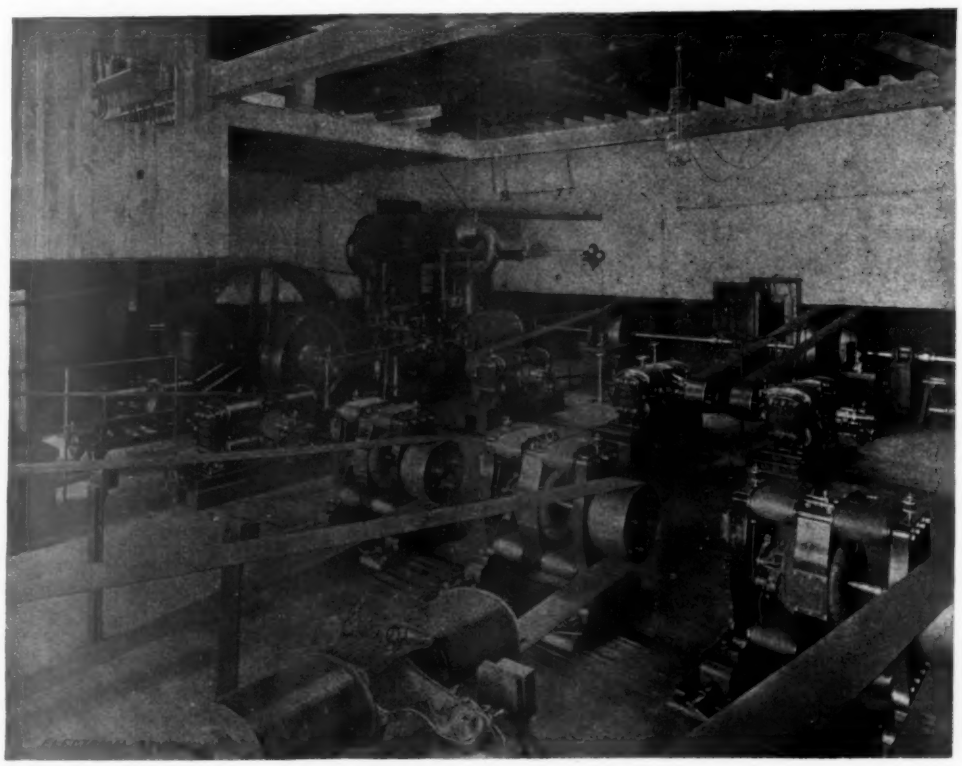


FIG. 2.—DYNAMO ROOM OF THE UNITED STATES ELECTRIC LIGHT COMPANY'S PLANT AT BLACK ROCK, BUFFALO, N. Y.

These are driven by two compound and and five direct acting high pressure engines aggregating 1,150 horse-power from the shops of the John T. Noye Manufacturing Company, of Buffalo.

Steam is supplied by four horizontal tubular boilers fitted with the Brightman mechanical stoker, which reduces the labor very materially and allows the working force to be reduced to the minimum.

The total capacity of the plant is 4,800 incandescent and 800 arc lights. The present day circuit carries about 1,000 incandescent and 100 arc, used for commercial purposes, and on the night circuit there are in the neighborhood of 3,000 incandescent and 650 arc lights.

A traveling crane suspended from the rafters of the ceiling runs over all the dynamos and connects through a hatchway with a similar crane on the floor above leading to the machine shop, so that, in the event of any of the machines getting out of order, they can be raised from their foundations, repaired and replaced with the smallest possible loss of time and labor.

A cold-air duct runs under the floor and from this are pipes connecting with each machine, through which a five-ounce pressure of cold air is forced on to the armatures, keeping them cool at all times and assuring better service than could otherwise be obtained.

The arc and incandescent switchboards are a feature of the establishment, being constructed of slat boards firmly braced, with the wires running up between them. The arc switchboard has a capacity of 48 circuits, or 2,000 arc lights, and is fitted with snap switches for the ready insertion of ammeter plugs for determining the strength of current on each circuit.

The incandescent switchboard is arranged so as to be perfectly interchangeable, and in case of accident to any one dynamo, another can be instantly thrown into the same circuit.

The second floor is occupied by the machine shop, stock-room, lamp repair-room, and here is also one 1,000 horse-power Stuart heater and one 500 horse-power heater of the Berryman type. The feed water is heated through these to a temperature of 200 degrees before entering the boilers.

On this floor also is located the ash pit, the ashes being brought from the furnaces in traveling buckets and dumped into a chute which carries them directly into the carts.

The Thomson-Houston and the United States Electric Lighting Company have recently consolidated their interests, and Mr. E. C. Shaw, the former superintendent of the Thomson-Houston Company, under whose able management the business has been conducted for some time past, and to whose efforts the present flourishing condition is largely due, has been appointed general manager of both companies.

Mr. Shaw is a member of the Society of Mechanical Engineers and a thoroughly practical and competent man for the position.

The Bickford & Francis Belting Company.

This firm, which is one of the old established business houses of Buffalo, was founded by Mr. Richmond H. Bickford in 1867.

BELT FOR BRUSH ELECTRIC LIGHT COMPANY, BUFFALO.—MADE BY THE BICKFORD & FRANCIS BELTING COMPANY, BUFFALO.

Mr. Bickford came to Buffalo in that year after having had a large experience in the manufacture of leather belting in the East, and the firm was started under the name of Bickford & Curtis. The house has passed through some changes in name since that time, but Mr. Bickford has always been at the head of the firm and has established a reputation is the trade unsurpassed by any other belting manufacturer in the country.

The building they now occupy was built by them in 1888; it is a six-story structure and affords them unrivaled facilities for the manufacture of leather belting of every size and width that is in demand.

They have recently turned out a belt for the new Corliss engine now being placed in position at the station of the Brush Electric Light Company, in Buffalo, which is probably the largest belt ever manufactured out of leather. It is 129½ feet long, six feet wide, and required the hides of 240 cattle in its construction. The accompanying cut will give an idea of its size as compared with the average man.

The firm are doing a large and steadily increasing business in the electrical field all over the country, and where their favorite brand, B. C. and D., appears upon a belt, it needs no higher recommendation as to quality among the users of leather belting. Its reputation is fully sustained in their own home market, which is always a sure test of merit.

Eagle Grove, Ia., is talking of electric street lighting.

It is said that a syndicate of Swiss and English capitalists has been formed to utilize a part of the falls of the Rhine, at Lauffenburg, for the generation of electric energy. Turbines will be used and 7,000 horse-power will be developed.

Queen & Company, Philadelphia.

While the electrical industry is of comparatively recent growth, yet it is interesting to note that a few of the leading companies engaged in it date back a good many years and were well established in business before electricity claimed the public mind to any considerable extent.

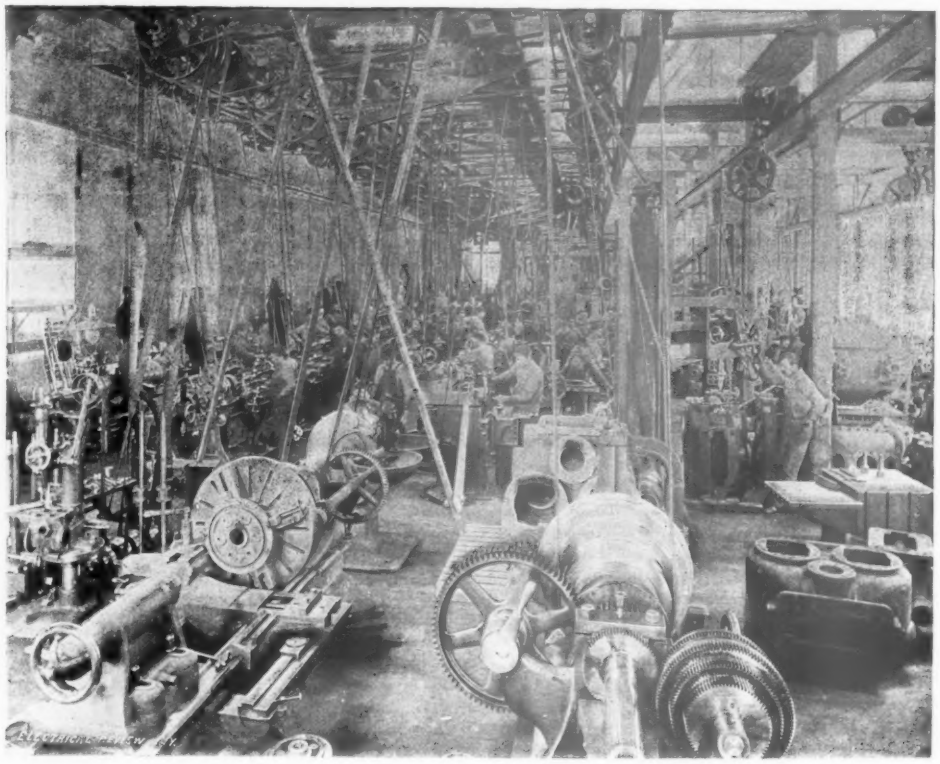


FIG. 1.—MACHINE SHOP OF SNOW STEAM PUMP WORKS, BUFFALO.

Prominent among such houses is the establishment of Queen & Company, Philadelphia, who for nearly 40 years past have been the leading scientific instrument house in the country.

The readers of this journal doubtless know Queen & Company only as makers of high-grade electrical apparatus, such as ammeters, voltmeters, galvanometers and resistance boxes, and it may be something of a surprise to learn that besides goods of this character they manufacture or import everything scientific, from an opera glass to a surveyors' transit and from a photographic camera to an equatorial telescope. The business is divided into eight distinct departments, each one of which is conducted by a separate management and like so many different firms doing business under one roof. The branches are as follows: Department 1, Optical instruments; Department 2, Engineering, surveying and drawing instruments; Department 3, Microscopes and accessories; Department 4, Philosophical and electrical instruments; Department 5, Astronomical and projection apparatus; Department 6, Meteorological instruments; Department 7, Photographic apparatus; Department 8, Chemical apparatus. It takes 16 large catalogues to advertise the products of this firm, and when bound together the volume presents the appearance of a good-sized encyclopedia and is most valuable for scientific reference.

Queen & Company were for many years located at 924 Chestnut street, Philadelphia, where alterations and enlargements have at times been made to meet the requirements of their expanding business. It has been evident for several years past that the limit to the expansion of the building had been reached and that larger quarters must be found. It is not surprising, therefore, to learn that they have recently removed their offices, showrooms and warehouse to 1010 Chestnut street, where a much larger building affords the desired facilities for attending to the vast business which comes from all parts of the world. The electrical department is located on the second floor, within easy access by elevator, and the display of these fine instruments is most complete and interesting. Queen & Company have for a long time made a great specialty of equipping college laboratories with scientific apparatus of all kinds for demonstration purposes and practical work. Many such installations have comprised electrical engineering outfits of the most complete proportions, the instruments having been made in Philadelphia or imported from the leading European manufacturers.

The factory in which Queen & Company make their scientific apparatus is quite near the main building, at 819 Filbert street. Here 75 skilled mechanics are employed and the machinery and special tools are of the latest designs. A foundry is part of the establishment, where all castings are made.

In consideration of all the important changes noted above, and which have been recently made in the establishment of Queen & Company, we predict for the house a great future. With a reputation throughout the whole country and extending back so many years, with the best facilities for manufacturing and exploiting their scientific apparatus, and with competent and experienced men at the head of each department, it does not seem possible for a house always successful in whatever it undertakes to do other than continue at the front. The electrical department is being operated with special vigor, and the continuous run of orders, both large and small, for all instruments required for testing purposes speak conclusively of the standing of this great house.

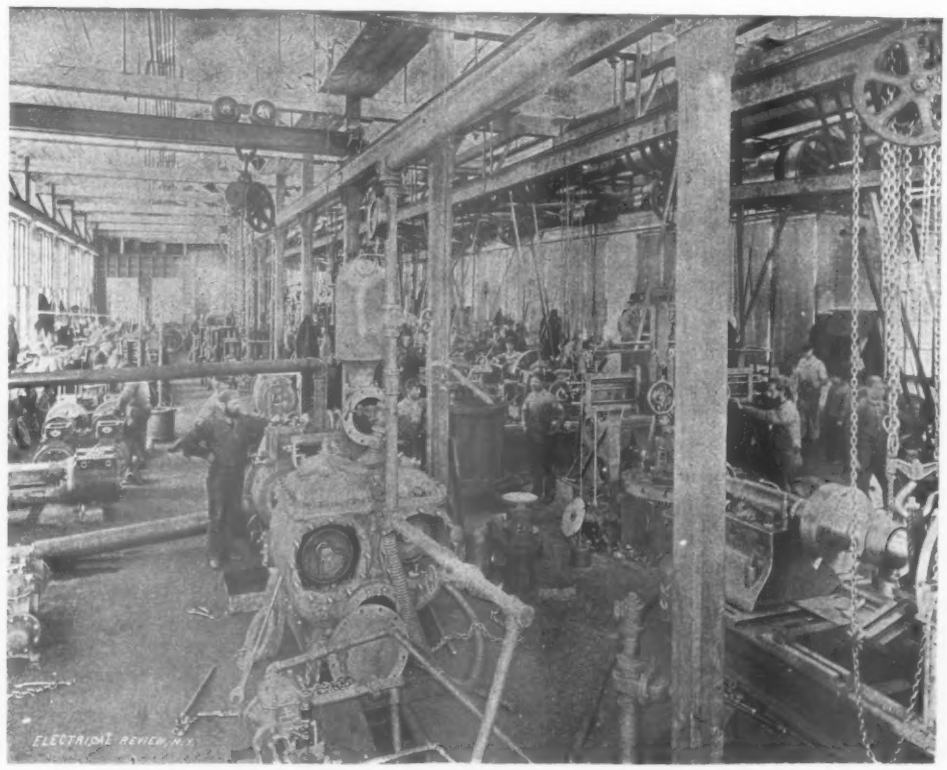


FIG. 2.—MACHINE SHOP OF SNOW STEAM PUMP WORKS, BUFFALO.

In connection with the electrical department a new testing laboratory has recently been located at Ardmore, a few miles from the city. No expense has been spared to make this testing department so complete that every sort of work can be done with the greatest accuracy. Special dynamos, storage cells, special galvanometers, resistance boxes and standards of resistance, current and electromotive force have been installed and are in charge of competent men, trained specially for the work. The new laboratory will be of great advantage, for up to this year the testing and calibration of the Queen instruments have been attended to by outside parties, who for unavoidable reasons could not give the same attention to the small yet important details as they will now receive from the makers themselves

The Snow Steam Pump Works, of Buffalo, N. Y.

The Snow Steam Pump Works, of Buffalo, was organized in January, 1890, with a capital of $100,000. The business increased so rapidly that in 1891 $50,000 was added to the capital stock, and, to keep up with the rapid increase of business, $100,000 has recently been added, making the capital stock $250,000. The business is established in shops unsurpassed for completeness and general excellence of equipment and convenience of location.

The works are situated on Snow and Roesser avenues in the city of Buffalo; a center of three trunk lines of railroads, and switches to connect with other roads give them unusual facilities for the reception of material and the quick transit of outgoing manufactures.

As to their pumps, it is only necessary to state that they are mainly of the duplex pattern, the workmanship is of the highest quality and the material used the best to be found in the market.

Besides the duplex pumps, the Snow Steam Pump Works manufacture low-service pumps, underwriter fire pumps, regular pattern fire pumps, brewery, sinking, marine, bilge, air, power, pressure, mine and waterworks pumps, in fact, special pumps for any particular service. In the underwriter fire pump the Snow Steam Pump Works have developed and perfected a pump which was specified by the Associated Factory Mutual Insurance Companies and accepted and recommended by them, several of these pumps being now in successful operation.

The rapidity with which the Snow pumps have taken the front rank, not only in the United States, but also in foreign countries, as England, Germany, Italy, Holland, Cuba, South America, the West Indies and British Columbia, justify their claim to superiority.

The best talent in the United States is employed, and every pump is fully guaranteed to perform as represented.

Fire in a Telephone Exchange.

The branch exchange of the Metropolitan Telephone and Telegraph Company, at Eighteenth street and Broadway, New York, caught fire about six o'clock in the evening of February 13. The exchange is located on the top floor of a five-story building. The fire started on the fourth floor and worked its way up to the roof. After the flames were extinguished it was found that the $200,000 switchboard was but slightly damaged, the greatest loss being from water. The board has nearly 2,000 drops. The Spring street exchange picked up most of the damaged circuits, so that the Eighteenth street district was not entirely cut off.

Edison General Electric Company, Buffalo.

The Buffalo branch store of the Edison General Electric Company, of which the accompanying illustrations will give some idea, is, without doubt, the handsomest establishment of this kind in the city. It is located in the Masonic Temple building at 41 Niagara street, and has a frontage of 25 feet and a depth of 150 feet.

Corliss Engine Manufactured by Geo. W. Tifft's Sons, Buffalo.

It is divided into two sections, the front part being occupied by the salesroom and the general and private offices. The store throughout has been fitted up in the best possible manner, the counters, fixtures, and in fact all the woodwork of every description being of natural oak. Of the offices, the first one to be reached is the general office, where are located the desks of the clerks, and adjoining this in the rear and connected by glass doors are the private offices of Mr. Henry B. Oakman and the various agents. Here, as elsewhere, no expense has been spared, and the appointments are first-class in every particular.

In the store itself there is an exhibition plant of two 55 light machines run by a 10 horse-power Case engine, which furnishes the necessary light and from which current is carried to the rear room and turned into the numerous electroliers there exhibited.

The dynamos are situated on the left hand side from the entrance, and are run in tandem from one pulley. The switchboard, which is also of natural oak and very handsome, is on the opposite side of the store and gives an excellent illustration of the working of the Edison three-wire system. The wires are carried from the dynamos under the floor and run up inside of the switchboard, which is deep enough to allow plenty of space in which to reach them if necessary.

Fig. 2.—Store of Edison General Electric Company, Buffalo.

In the rear of the offices is the main fixture show room, and here are exhibited the latest designs in electroliers for indoor and outdoor purposes. There are at present on exhibition here in the neighborhood of 50 portables and over 100 chandeliers and brackets.

The effect when these are all lighted up at the same time is something dazzling.

In the basement, which extends the entire depth of the building, is located the storeroom, and here the various supplies are neatly stowed away in partitions reaching from floor to ceiling and extending along the sides of the room. The floor space is fully covered with the goods of heavier description.

The store was opened September 1, 1891, and the business since that time has more than justified the expense incurred by the company in fitting it up.

The Masonic Temple, in which the store is located, is probably the handsomest building of the kind in this part of the country and has one of the latest Edison plants, with a capacity of about 800 lights. The fixtures used throughout are also manufactured by the Edison General Electric Company.

Among the recent contracts closed from this branch is one for the North Tonawanda Street Railway Company. An entire Edison outfit was included.

George W. Tifft's Sons & Company.

This plant is the oldest of the kind in Buffalo and was known 40 years ago as the Buffalo Steam Engine Works.

The only Corliss engines made in this city are turned out at these works, and as an example of their quality and durability, it may be mentioned that the shop engine of this type now in use has been running continuously for that length of time, and is still in a remarkably active condition. The works cover about two and a half acres of ground and employ, on an average, about 200 men.

In addition to their Corliss engines the company manufactures high speed and plain engines of all sizes and for any kind of work from 12 horse-power up. They also go largely into the manufacture of boilers, general machinery, shafting, pulleys, etc., and at the present time are crowded to their full capacity.

The accompanying illustration shows one of their Corliss engines in the process of being set up in the shop.

WORLD'S FAIR NEWS.

The prospectus of the Department of Electricity, which was issued on the 6th, is short, but contains all the information that is thought needful for exhibitors in this department. The scope of the department is stated to be "the demonstration in actual operation of the commercial and economic applications of electricity. It is desired, however, to make exhaustive tests of electrical apparatus in all possible directions with a view to establishing the actual efficiency of the same in comparison with other and older methods of accomplishment."

Object lessons, showing the development of the science from its earliest stage by means of the historical exhibit, are also contemplated.

In relation to the lighting of the grounds, it is stated that about 8,000 arc lamps of 2,000 nominal candle-power each and about 130,000 sixteen candle-power incandescent lamps will be needed. Besides this, from 3,000 to 3,500 horse-power will be required for the operation of the machinery of exhibitors. This will be transmitted by electricity from the central power station. In relation to the central station the prospectus says: "To furnish and transmit this 24,000 horse-power, the Exposition Company will construct a plant which, though a complete station in itself, will be composed of a number of smaller complete plants installed by those who contract to furnish certain parts of the service. These plants will be primarily for the service of the Exposition, but are not for that purpose prohibited from becoming competitive exhibits as well, provided the usual course is taken by their owners of making the proper application of exhibitors through the office of the Director-General."

Fig. 1.—Show Room of Edison General Electric Company, Buffalo.

Electric power, it is expected, will be used for the intermural railway that will constitute a part of the service of the Exposition, although this question has not been definitely settled.

Arrangements for exhibition of electric cars in operation will also be made although the necessary space has not yet been located.

Displays of electrical mining machinery and electrical metal working machinery will constitute an important portion of the exhibits in the department.

In relation to artistic lighting effects the prospectus states that small chambers illustrating varied effects promise to be popular with exhibitors and all proper aid will be extended by the department looking to the best possible results.

The concluding paragraph of the general statement is as follows: "It is superfluous to add that every possible field of electrical work will be liberally considered and that all systems of all countries will be placed as favorably as possible to the end that the best results may accrue to the electrical people and the public at large."

The electrical building is then described and also the manner of securing space by applying to the Director-General of the Exposition. In reference to the installation of exhibits it is stated that all electrical apparatus, excepting generators and the adjuncts of the generating plant, must be shown in the electrical building where electrical power only will be furnished. Generators to be operated by steam power cannot be installed in the electrical building but will be located at some other point.

In reference to the much-talked-about question of the relation of exhibits of dynamos and the service plant, the prospectus says: The power station will contain the plant under contract to serve the Exposition, and will probably contain the generators of those exhibitors who contemplate exhibiting generating plants of sufficient capacity only to operate the balance of their exhibits in the Electrical building, and steam power for the running of these generators will be furnished by the Exposition Company at a moderate price, the figures to be fixed hereafter. In the event that it may be found undesirable to combine the actual service machinery with the purely exhibitive generators, some acceptable site will be found for the latter within reach of power. Appliances and apparatus, such as electrical elevators, search-lights, etc., intended for exhibition, but offered and accepted for the service of the Exposition, may be installed wherever their service is required without forfeiture of their rights as competitive exhibits, provided that such outside location shall have been approved by the Director-General.

Ample facilities will be provided for moving pieces of machinery weighing no more than 30,000 pounds. Any article weighing more than this will require an extra charge for installation. Empty packing cases may be stored at a maximum rate of two cents per cubic foot; with insurance two and one-half cents will be the charges for this service.

Foreign exhibits may be entered free of duty, in bond; if sold, the regular duty will be collected.

In conclusion, it is stated that the officers of the Exposition must for obvious reasons assume arbitrary power in acceptance of exhibits and the allotment of space. This power, however, will be exercised with the view to aiding the greatest possible number of exhibitors to make the most of the opportunity afforded by so great an Exposition. The special department rules, which have been already published, were appended.

The Short Motors in Snow.

It appears to be a curious and interesting feature of the Short gearless motor that it will operate perfectly during snow storms, maintaining the schedule time. The only reasonable explanation of this is found in the fact that the weight of the motor is centered directly over the axle, so that maximum traction is attained. In support of this theory it is noticed that the wheels of the gearless motor rarely or never slip even under the worst conditions of track. Another reason is probably found in the special controlling device used by the Short Company which prevents a sudden rush of current through the motors, which frequently starts the wheels to slipping and prevents them from taking a good grip on the rail. That this latter explanation has some weight is proven by the fact that the Short double reduction motors have operated during the past month under especially severe conditions of track and weather. In Braddock, Pa., two 15 horse-power Short double reduction motors are operating cars on 12 and 13 per cent. grades during heavy snow and sleet storms, and without missing a single trip. In Cleveland, two Short motors carried a car through four or five inches of unbroken snow over a disused switch, and started up without difficulty under the same conditions. In Jamestown, N. Y., the Short double reduction motors have operated right through the heavy snow storms over a succession of grades varying from six to ten per cent. with sharp curves, and the railway people are surprised and delighted at their performance.

The first electric railway in Russia is to be constructed in Kiel, a city of about 130,000 inhabitants, on the river Dnieper.

A bill has been introduced in the English House of Commons authorizing the construction of a new underground electric railroad from Waterloo Station, under the river Thames, to Baker street station. The total length of the road is three miles and the line is to cost £990,000.

The Lake Erie Engineering Company.

The immense strides made within the last few years in building up American commerce on the great lakes, together with the unusual activity displayed by the Government in reconstructing the navy, has gone far toward the development of the manufacturing interests through the West, and the large eastern concerns which have heretofore greatly monopolized the business of constructing heavy machinery, are now beginning to wake up to the fact that the West is producing some manufacturing concerns which promise, in the near future, to prove very formidable rivals.

Among these concerns the Lake Erie Engineering Company stands prominently to the front, and within the past year additions have been made to their plant and new machinery added, so that to-day they are in a position to handle contracts for the largest machinery turned out anywhere in the United States.

The company was started 15 years ago as the Lake Erie Boiler Works, and is to-day the largest marine boiler establishment in the United States. They have now gone into the manufacture of engines of the largest type, and Mr. Richard Hammond, the president and general manager of the company, expresses himself as being able to handle with ease anything in this line which may be offered. The new works, which have been built expressly for the purpose, are located on the corner of Chicago and Perry streets, and have a frontage of 425 feet on the former and 300 feet on the latter, and the buildings, which include the main building, the machine shops, a foundry and a blacksmith shop, are semi-detached, built entirely of red brick, iron, slate and glass, and are considered absolutely fire-proof.

The main building, which is 250x45 feet and three stories high, contains the offices, draughting rooms, pattern shops and storerooms. The machine shop, a view of the interior of which is presented herewith, is 370x180 feet, and contains some of the largest tools ever turned out for machinery purposes. Among these may be mentioned a planer weighing over 152 tons, constructed to plane a casting 20 feet wide, 12 feet high and 30 feet long. This machine runs four cutting tools at once, each of which will cut a shaving three inches wide and one-quarter of an inch deep. There is also a large boring and turning mill, capable of boring or turning a fly-wheel or pulley 30 feet in diameter and eight foot face. This machine has six cutting tools, two on the cross rail and four special ones on the main bed, all feeding automatically. The mill weighs 135 tons.

Similar to the above in all but size, is a 10 foot boring and turning mill, and another monster, also the production of Mr. Hammond's ingenuity, is a horizontal boring, drilling and milling machine, which is the most ingenious labor-saving device imaginable. It will bore, drill, or mill the face of a casting—at one setting—18 feet long, 12 feet high and eight feet thick. The total weight of the tool is 90 tons.

FIG. 3.—MACHINE SHOP OF THE LAKE ERIE ENGINEERING COMPANY, BUFFALO.

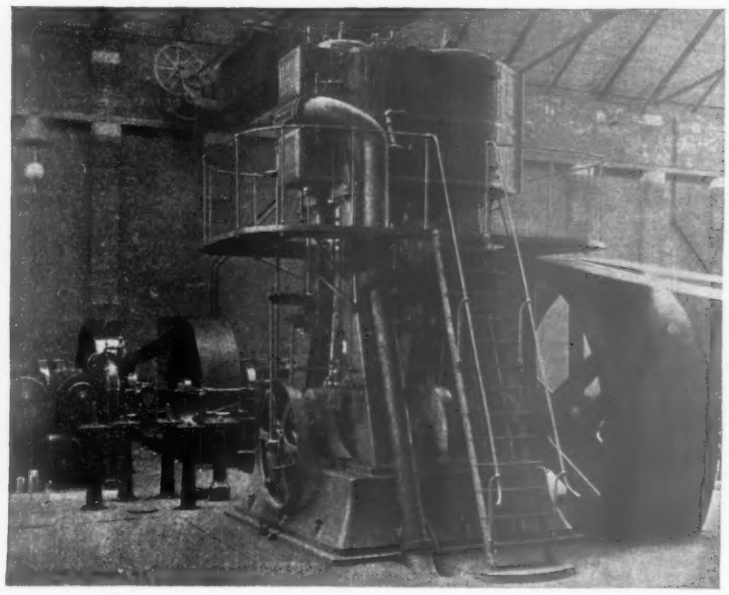


FIG. 1.—ENGINE AT THE POWER STATION OF THE BUFFALO STREET RAILWAY COMPANY—BUILT BY THE LAKE ERIE ENGINEERING COMPANY, BUFFALO.

There are also numbers of other specially designed tools of the most improved type, and a most important feature of the shop is an electric traveling crane with a lifting capacity of 35 tons. This electrical giant will lift the heaviest piece of casting 40 feet into the air, carry it from one end of the shop to the other, and deposit it with the utmost accuracy wherever desired, in the space of about a minute and a half, as easily as the average man could trundle a baby carriage.

The foundry, which covers an area of 300x108 feet, contains four moulding pits, 30 feet in diameter and 12 feet deep; two core ovens 20 feet wide, 28 feet long and 18 feet high; two cupolas, one with a melting capacity of 30 tons per hour and the other 15 tons, and a 20-ton hydraulic hoist for lifting the stock to the cupola platforms. The equipment includes also five traveling cranes of from five to 25 tons capacity, and six hydraulic jib cranes for handling light work.

This is undoubtedly the best equipped and most perfectly lighted foundry in the country. Aside from the vast number of windows, the roof is almost one continual sky-light, the ribbed glass employed in this part of the construction alone costing $10,000. At night it is brilliantly illuminated by 200 incandescent and 12 arc lights.

The pattern shop, which, in a concern of this kind, is naturally a very important feature, is located in the main building and occupies the whole three floors, 150x45 feet. The latest improved machinery and the heaviest tools ever built for this class of work are found here. The pattern storerooms occupies a space 45x60 feet on the three floors in the middle of the building.

The main building is lighted by 300 incandescent lamps, and the works are heated throughout by exhaust steam from the engines in the different buildings.

No expense or pains have been spared to make the entire plant perfect in every respect, the total cost of the buildings and machinery footing up to $350,000.

The accompanying illustration shows one of the 500 horse-power vertical engines, recently installed by the Lake Erie Engineering Company, at the power station of the Buffalo Street Railway Company, and another just like it is now almost completed, and will be set up alongside of the first one.

These engines are of the newest design, and are particularly adapted to the arduous work required in this branch of service. Some idea of the severe strain to which they are subjected may be gathered from the fact that frequently the load on them varies in the space of a few seconds from 30 horse-power to 500 horse-power, and under these circumstances it is required that their speed should not vary either way over two and one-half per cent.

In other words, if the engine is making 100 revolutions per minute when the load is entirely off, it must not make less than 97½ revolutions per minute when a load of 500 horse-power is suddenly thrown on. The governor must be, and is, capable of either turning on or cutting off all steam before the speed has varied two and one-half per cent.

The rapid progress in the development of electrical machinery is continually widening the field for improved designs in steam engines, and the old, slow speed horizontal engine is rapidly giving place to the less bulky, vertical triple expansion type, which gives better results, and at the same time insures economy of fuel and floor space, which, in these days of valuable property and close competition, are two very important factors.

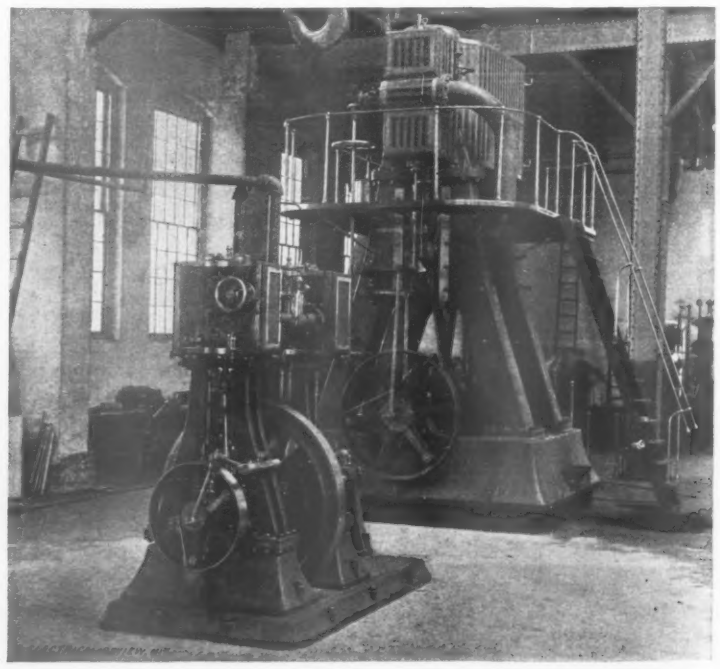


FIG. 2.—ENGINES AT THE POWER STATION OF THE BUFFALO STREET RAILWAY COMPANY—BUILT BY THE LAKE ERIE ENGINEERING COMPANY, BUFFALO.

The John T. Noye Manufacturing Company.

The original business of this concern was established in 1834, under the name of Jno. T. Noye & Sons, for the manufacture of flour mill machinery, and while the present firm of The Jno. T. Noye Manufacturing Company, which succeeded the old firm in 1882, have branched out largely into the manufacture of engines for other purposes, the original business is still carried on and the firm enjoys the reputation of being the oldest and most successful establishment in that line of trade.

In 1885, when the rapidly growing electrical industry was causing a demand for high grade engines for railway service and large electric light stations, the firm added an engine department to their already large plant, and went extensively into the construction of their celebrated Rice automatic high speed engine, which, since that time, has become so intimately associated with the success of the electric power plants throughout the country.

This engine, which is conceded by experts to be unequaled for the simplicity and grace of its construction lines, is now built in 33 different sizes, suitable for the various lines of work demanded of it, and ranges from eight to 300 horse-power. There are in all about 100 engines of the Rice type in successful operation in the city of Buffalo alone.

In addition, the company has recently designed a special heavy duty high grade engine suitable for large electrical plants, and, although comparatively new in the market, it is finding favor rapidly in the field it was constructed to reach. There are already 16 different sizes of this engine turned out, ranging from 135 to 554 horse-power. The Edison Illuminating Company, of Detroit, have recently put in a 400 horse-power engine of this type, and others are to be found at Easton, Pa., in the works of the Alsip Brick Company, of Chicago, and at the Dakota Elevator, in Buffalo.

The company is now building one of 150 horse-power for the Joplin Electric Light Company, of Joplin, Mo., and two tandem compounds of 400 horse-power each for the Jamestown Street Railway Company, of Jamestown, N. Y.

As will be seen by the illustrations of two departments in the shops, the company have every facility for turning out their engines in large numbers and in the best possible shape.

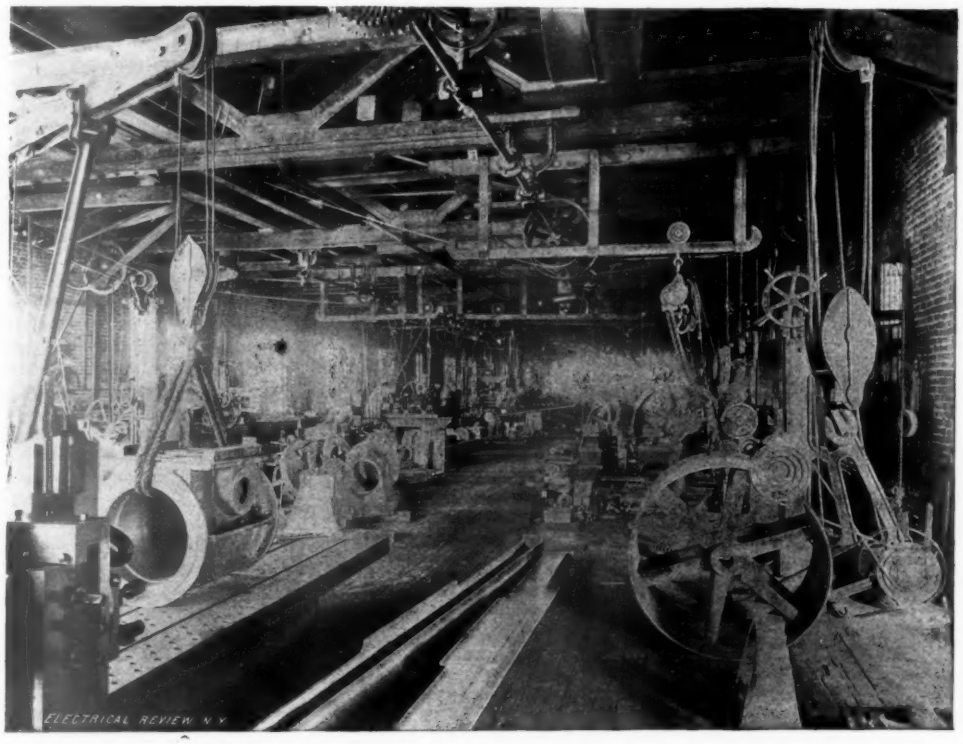


FIG. 1.—MACHINE SHOP OF THE JOHN T. NOYE MANUFACTURING COMPANY, BUFFALO.

A Southern Electric Road.

The Atlanta and Chattahoochee, Ga., Electric Railway is under contract for an elaborate electrical equipment, to be in operation by the end of February, and by that time it is expected that 15 miles of track will be completed.

Nearly half this track will be inside the city limits, and the new line promises to be one of the most important in Atlanta. A feature of the equipment is the laying of the track with 56 pound steel rails calculated to stand heavy freight as well as passenger traffic.

The electrical equipment is of the latest pattern, and embraces improved appliances not heretofore used in Atlanta. The contracting firm is the Short Electric Railway Company, of Cleveland, Ohio. The projectors of the line are Mr. C. J. Simmons and Dr. Baker, who built the road, not with Northern capital, but with their own resources and the assistance secured along the line. Mr. C. J. Simmons, of the Atlanta and Chattahoochee River Railroad Company, has just returned from New York and Cleveland, where he went to buy the electrical equipment for his line.

Mr. W. S. Atchison, the special agent of the Short Electric Railway Company, of Cleveland, Ohio, was in the city recently, and gave an interesting description of the plant and equipment which that company has contracted to furnish this line of road.

"The Atlanta and Chattahoochee Railway will have 15 miles of track," said he, "and all of it will be laid with 56 pound steel rails, bonded up with No. 4 galvanized iron wire.

"The power house will be built of granite taken from the quarry which is in that immediate neighborhood, and will be 60x100 feet. The equipment will consist of two 150 horse-power Reynolds-Corliss engines and four 150 horse-power steel return tubular boilers, with duplex pumps and feed water heaters. The electrical equipment will consist of two 150 horse-power Short dynamos, with full station apparatus.

"The car equipment will consist of twenty 20 horse-power Short gearless motors placed on 10 cars. Four will be closed and six open cars of J. G. Brill's best make. The closed cars will seat 40 and the open cars will seat 50 people nicely. Over 100 persons may be crowded on them."

FIG. 2.—MOULDING ROOM OF THE JOHN T. NOYE MANUFACTURING COMPANY, BUFFALO.

The Patent Office.

Commissioner Simonds, of the Patent Office, submitted his annual report to Congress on January 30. The report recommends the following amendments to the Patent and Trade Mark law:

First—That no improvement shal be patentable which has been, for more than two years before application for patent thereon, disclosed in any patent or printed publication issued in this country.

Second—That a patent shall not expire with the expiration of a prior foreign patent for the same invention.

Third—Compelling an applicant to take action upon his application at least once in every six months, in lieu of once in two years, as at present; and that a patent shall in no case live for more than 20 years from the date of the first application.

Fourth—Requiring patent licenses to be recorded the same as assignments and grants.

Fifth—Putting aliens upon the same footing as citizens as to the filing of caveats.

Sixth—Abolishing interference contests in the Patent Office and relegating them to the courts.

Seventh—Requiring a fee of $10 for every appeal or petition taken from a primary examiner directly to the Commissioner of Patents.

Eighth—Providing that no damages or profits shall be recovered in a suit for infringement except such as accrue within the six years last preceding the bringing of the suit.

Ninth—Providing that an injunction issued by a court against the transfer of a patent may be registered in the Patent Office and thereupon be constructive notice to all the world.

Tenth—Giving courts of equitable jurisdiction power to pass on the title to letters patent in a proper case without any action on the part of the defendant.

Eleventh—That the Commissioner of Patents may refund to the payer money paid into the Patent Office by mistake.

Twelfth—Defining the duties of the Assistant Commissioner of Patents.

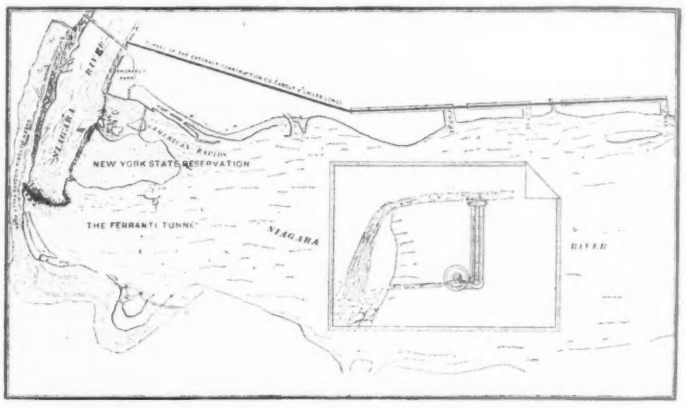
Thirteenth—Permitting registry of trade marks which are used in commerce between the States, the permission now being restricted to trade marks used in foreign commerce or in commerce with the Indian tribes.

The following is a summary of the business of the office during the last calendar year: Total number of applications received, excluding applications for the registration of trade marks and labels, 40,552; total number of patents granted, 23,244; total number of registrations, 1,899; total receipts, $1,271,283; total expenditures, $1,139,713; leaving a surplus of $131,572; making a total balance in the Treasury to the credit of the patent fund of $4,004,317.

Patents were issued to the residents of the several States and Territories as follows: Alabama, 82; Arizona Territory, 9; Arkansas, 103; California, 622; Colorado, 199; Connecticut, 733; Delaware, 34; District of Columbia, 219; Florida, 52; Georgia, 124; Idaho, 14; Illinois, 1,968; Indian Territory, 6; Indiana, 570; Iowa, 427; Kansas, 263; Kentucky, 195; Louisiana, 122; Maine, 142; Maryland, 294; Massachusetts, 2,122; Michigan, 752; Minnesota, 352; Mississippi, 63; Missouri, 786; Montana, 42; Nebraska, 191; Nevada, 10; New Hampshire, 144; New Jersey, 960; New Mexico, 14; New York, 3,907; North Carolina, 76; North Dakota, 29; Ohio, 1,513; Oklahoma, 6; Oregon, 71; Pennsylvania, 2,197; Rhode Island, 290; South Carolina, 49; South Dakota, 53; Tennessee, 161; Texas, 330; Utah, 25; Vermont, 55; Virginia, 165; Washington, 79; West Virginia, 74; Wisconsin, 526; Wyoming, 3; United States Army, 5; United States Navy, 8. Total, 21,236. The total number issued to foreigners was 1,298.

The Niagara Falls Tunnel.

A matter of great and rapidly growing interest to power users throughout the country, and one of special importance to the manufacturing industries of Buffalo, is the work now under way on the celebrated tunnel at Niagara Falls which, when completed, is destined to prove such an important factor in the future development of transmission of power by electricity. As the city of Buffalo will probably be the first of our manufacturing centers to feel the benefits of this mighty agency, which has been allowed to lie dormant for so many years, a few words of description of what is being done on this great engineering work may prove interesting at this time.



PLAN OF THE WORK ON THE GREAT TUNNEL AT NIAGARA FALLS.

The firm of Rogers & Clement secured the contract for the work from the Niagara Falls Power Company on September 12, 1890, and actual operations were begun in October of the same year. A canal, 1,200 feet long and 200 feet wide at the outer end, was started from the upper river level above the falls. This canal was gradually narrowed until at the inland end the width was 100 feet. At this point a shaft was sunk. The tunnel, which is 6,700 feet long, empties into the river below the falls, not far from the small suspension bridge.

The mouth of the tunnel is 214 feet below the top of the river bank and ascends from that point to the shaft at the end of the canal on a grade of 36 feet to the mile.

Shaft No. 1 is 206 feet deep, and at a depth of 105 feet from the surface great difficulty was experienced from the excessive flow of water, which at this point averaged 800 gallons per minute.

In shaft No. 2, which is 196 feet deep, the flow was not so great, averaging about 600 gallons per minute, and very little trouble from this cause was encountered below 70 feet from the surface.

The great quantity of water made the fitting up and sinking of shafts Nos. 1 and 2 very tedious and expensive work, but the portal shaft, or "zero" as it is called, work on which was begun in February, 1891, was sunk rapidly and with very little interruption.

Owing to the dangerous nature of the rock encountered, it was found necessary to prop with heavy timbers close up to the cuttings in advance of the brick work, and work progressed very slowly up to July, 1891, from which time much better progress was made.

As the work progressed it was found necessary to make several changes in the original plans, the final ones being adopted in June, 1891.

The method used for boring the headings was the American center cut system, four drills being used in the portal heading and two in each of the others. The rock in the portal and part of shaft 1 was hard limestone and in both headings of shaft 2, Utica slate.

The best record for speed, and one which probably equals anything heretofore accomplished in tunneling, was made in the portal heading between November 28 and December 24, 1891, on which date the last heading between the upper and lower shafts was broken through. In this time, 26¼ days, a progress of 338 feet was made.

Messrs. Rogers and Clement, the contractors, attribute the good work done under the many adverse circumstances, to the excellent system in vogue and the superior grade of workmen employed.

Unless some unexpected difficulties arise, the entire work will probably be finished by September, 1892, and so confident of this do the managers feel that they have already contracted to furnish power to one corporation next Autumn, and stand ready to make other similar contracts.

In the power station, located at shaft No. 2, are eight 100 horse-power boilers, built by the Porter Manufacturing Company, three 18x30 inch Rand duplex air compressers, a Thomson-Houston electric light plant, by which the tunnel is lighted throughout, and a sawmill with a capacity of 20,000 feet per day.

The shafts are fitted with Otis automatic hoisting engines, shafts Nos. 1 and 2 having double cages and shaft zero a single cage. The pumping plant at shaft 2 consists of four No. 7 and one No. 9 Cameron pumps, and at shaft No. 1 of two No. 7 and two No. 9 Cameron's, and three Snow pumps.

At shaft 1 there is also an auxiliary boiler plant of two 60 horse-power boilers, and at shaft zero one 75 horse-power boiler for supplying steam to the pumps and hoisters.

The drills used on the work were 25 "little giants," No. 3½, made by the Rand Drill Company, and three Sergeant drills. The explosive used for sinking the shafts through hard rock was a special high "rack-a-rock," and in driving the headings, Forcite powder.

On the whole, the great undertaking is progressing in the most favorable manner, and that the power from the falls will be in use in Buffalo within the present year is now almost an assured fact, and from the success already met with in the tests of transmissions of power by electricity, there is every reason to believe that the time is not far distant when the sturdy old giant of the falls will be bound hand and foot by the electric wire, and by its means his immeasurable power will be diverted over many miles of territory and utilized, as it never has been, in performing the numerous functions demanded of it in this progressive age.

The Electrocution Press Gag Amendment.

Governor Flower, of New York, on the 4th inst., signed the Stein amendment to the electrical execution act and it now becomes the law.

The following is a full text of the amendment:

Section 1, Section 507 of the Code of Criminal Procedure is hereby amended so as to read as follows:

"Sec. 507. It is the duty of the agent and warden to be present at the execution and to invite the presence, by at least three days' previous notice, of a Justice of the Supreme Court, the District Attorney, and the Sheriff of the county where the conviction was had, together with two physicians and 12 reputable citizens of full age, to be selected by said agent and warden. Such agent and warden must, at the request of the criminals, permit such ministers of the gospel, priests or clergymen of any religious denomination, not exceeding two, to be present at the execution, and in addition to the persons designated above, he shall also appoint seven assistants, or deputy sheriffs, who shall attend the execution. He shall permit no other person to be present at such execution except those designated in this section. Immediately after the execution a post-mortem examination of the body of the convict shall be made by the physicians present at the execution, and their report in writing, stating the nature of the examination so made by them, shall be annexed to the certificate hereinafter mentioned and filed therewith. After such post-mortem examination, the body, unless claimed by some relative or relatives of the person so executed, shall be interred in the graveyard or cemetery attached to the prison, with a sufficient quantity of quicklime to consume such body without delay; and no religious, or other services shall be held over the remains after such execution, except within the walls of the prison where said execution took place, and only in the presence of the officers of said prison, the person conducting said services, and the immediate family and relatives of said deceased prisoner. Any person who shall violate or omit to comply with any provision of this section shall be guilty of a misdemeanor."

Sec. 2. This act shall take effect immediately.

There was quite a serious fire in the Rutland, Vt., *Herald* building on the 5th inst., and among the sufferers was the Rutland Electric Light Company and M. J. Francisco & Son, having offices in the building.

The Kellogg Iron Works, Buffalo.

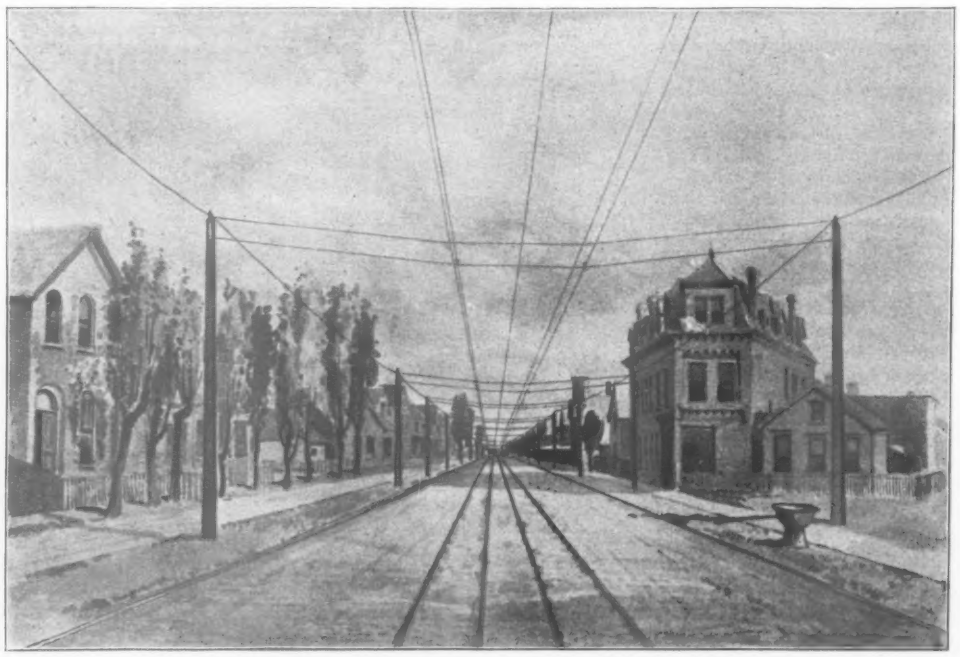
Among the leaders of the younger industries of Buffalo we take pleasure in mentioning the Kellogg Iron Works, who entered the field a few years ago in small quarters and with few men, while now they occupy three commodious buildings, one being entirely of iron and steel and of their own make, with nearly a half-acre under roof, a large number of hands steadily employed, and their buildings equipped with latest modern machinery adapted to their work.

Upon the entrance of the electric railway in their city, with characteristic enterprise, after looking over the ground and concluding there was room for yet another manufacturer of metal work for electric railways, they decided to extend and equip their works specially for that line of work and to enter the field.

That this was a wise conclusion may be judged from the fact that while heretofore this was their dull season, they are now running with a full force, mainly on electric railway work. At the power station of the Buffalo Railway Company you will see the largest electric traveler in the State. This is their work. Also look at the iron and steel work in the "hole in the ground" in the rear of the power house; trolley poles on Main, Sycamore and Washington streets; new and reconstructive work on the bridges on Main, Perry and Elk streets. While they give this class of work their special attention, they are glad to furnish plans and estimates for roofs, iron buildings and kindred structures, and during the year 1891 supplied the metal work for two Government and three New York State armories.

We give herewith a view of the line construction on Sycamore street, showing one form of pole made by the Kellogg Iron Works.

They extend a cordial invitation to "call and get acquainted," and we think, if you will accept, you will be well treated at their hands.



ELECTRIC RAILWAY CONSTRUCTION IN BUFFALO, SHOWING POLES MADE BY THE KELLOGG IRON WORKS.

The Philadelphia *Bulletin* states that Chauncey M. Depew, in an address to railroad men, expressed the opinion that every railroad in the country would be run by electricity within the next 25 years, and far-seeing men in the railroad business are beginning to look forward to the time when the locomotive will be a thing of the past and to prepare for the coming change.

The *Boston News Bureau* states that a good authority says that the New York Edison Illuminating Company earned last year enough to pay fixed charges, four per cent. dividends, and to carry over a very satisfactory surplus, and that the directors feel that the business has reached a point where they will be justified in increasing the dividends to five per cent.

The New York Car Wheel Works, Buffalo, N. Y.

Electricity as an element constitutes the basis of many different branches of industry, and binds them so closely together that one cannot be engaged in the pursuit of any particular line without becoming interested in its application to all other needs. Thus, the men who are perfecting motors are interested in the latest discoveries in the application of this subtle force to economical lighting, as the "light" investigators eagerly watch the development of "power" workers.

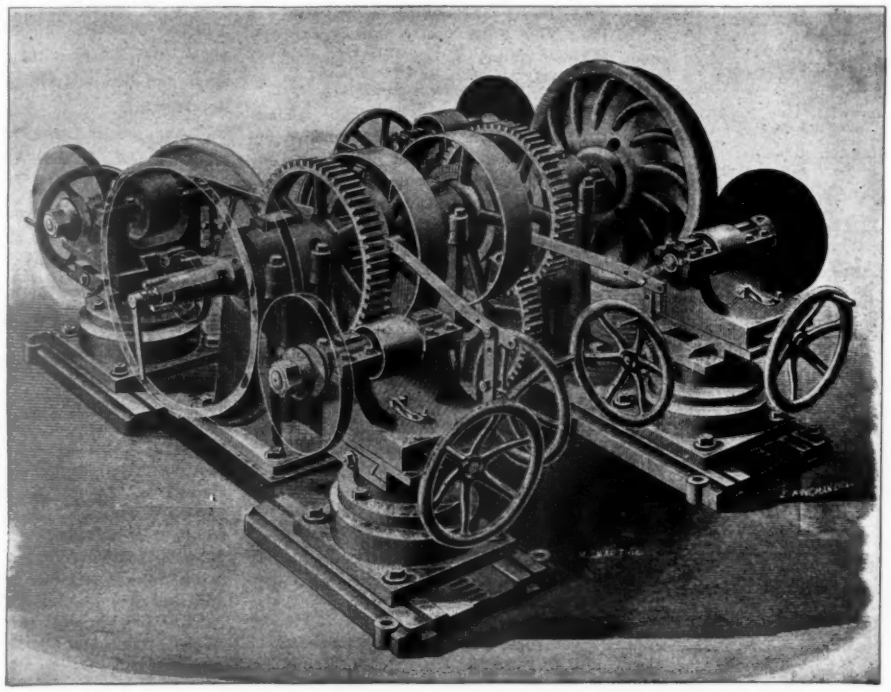


FIG. 1.—CAR WHEEL GRINDING MACHINE USED BY THE NEW YORK CAR WHEEL WORKS, BUFFALO, N. Y.

The practical and successful application of electricity is dependent in a very great degree on proper mechanical conditions. The discovery of what conditions are best suited to perfect operation by electricity has puzzled investigators more than the theory of what might be accomplished by this willing agent.

In view of these facts, it will be interesting to the electric light men assembled in convention at this time to know something of what has been done by a Buffalo concern in the development of perfect mechanical conditions as applied to the employment of electricity in the propulsion of street cars.

It will be admitted by all that in the equipment of an electrically propelled car the motor does not constitute all requisites to perfect and economical operation. The attention of electricians is just as closely drawn to parts with which the motor connects; and necessarily so, for the efficiency of a design depends on its ability to perform a given work.

There is no feature in the construction of a car which plays a more important part in the practical and economical operation of an electrical motor (and economy in operation is what makes the success of any device) than the wheels. This may not at once strike the theorist, nor even the men more practically employed in the application of the results of the theorist to the uses of commerce, but such, nevertheless, is the case.

It could not fail to occur to any man versed in mechanics that *elliptical* wheels would be worse than useless, and that to gradually reduce such a form to a circle would only make them less pernicious in definite proportion. The only form which will give perfect results is absolute rotundity. How many wheels are absolutely round as they come from the foundry, the condition in which they are used by the majority of electrical railways? Many are simply modified ellipses and in that form impose conditions on the motor not taken into calculation in its application, and which must necessarily result in undue expenditure of power and money.

The wheel must be treated mechanically to obtain perfect rotundity, but the difficulty in the way of attaining this result as a commercial success with chilled cast iron wheels has been overcome, it is claimed, by but one concern in the country, and that one is the New York Car Wheel Works, of Buffalo, N. Y.

The chilled surface (or tread) of the wheel is so hard that steel cutting tools have no effect upon it and it is impossible to turn the metal off in any lathe. Various machines have been devised for treating chilled iron with emery wheels, but in all of them the time taken to bring the wheel to perfect rotundity precludes the idea of making the process applicable to a large output and at a cost that would not add too largely to the selling price of the wheels. Furthermore, these machines were all constructed to grind wheels after they had been placed on axles. As wheels cast in the same mould will vary in circumference, one from the other, as much as $\frac{5}{16}$ of an inch in cases, due to changing conditions of expansion and contraction in pouring and cooling, it can be imagined what a variety of differences are found in a lot of 100 wheels. With a great deal of time and labor wheels can be gauged as to diameter and paired before being pressed on axles, but, as a matter of fact, this is not done with any degree of thoroughness, and the consequence is that in almost every case, wheels on the same axle vary in circumference, one from the other, one-quarter to one-half an inch. To grind two wheels differing thus to the same identical diameter after being pressed on an axle, it is obvious that more metal must come off the larger than the smaller one. There is, therefore, much undue waste of chilled or wearing surface in the large wheel, besides an important increase in the time required to bring both to the same diameter.

Recognizing all these facts and determined to perfect a machine which would rapidly and economically grind wheels before being pressed on axles, Mr. P. H. Griffin, president of the New York Car Wheel Works, set to work some years ago investigating machines already designed, building experimental machines, and spent much time and money until, finally, his efforts were entirely successful, and to-day his company controls the only machine which will grind car wheels absolutely true on a basis of efficiency and economy that makes it possible to treat the entire output of a foundry at a cost that adds but slightly to the expense. An illustration of the machine is given herewith, and its details will be understood without any lengthy explanation. The car wheels are placed on expanding self-centering mandrels and revolved. Emery wheels revolving in the opposite direction are brought in contact with the chilled surface or tread, and the work is completed with a minimum of labor and expense. After being ground the wheels are gauged and stenciled with numbers indicating their exact diameter, so that in pairing them it is only necessary to pick out wheels of certain gauge numbers.

It is unnecessary to dwell here on the benefits resulting from the use of absolutely perfect wheels in electrical service. A comparison of the results they give with the results obtained from using mismated wheels, the peripheries of which bear no true relation to the center, demonstrates conclusively what an immense gain is made by the use of the former in saving of power and life of wheels. Smoother riding cars, less duty imposed on the motor, better contact with rails, are a few points that may be mentioned in passing.

As stated in the beginning of this article, perfect mechanical conditions must exist before proper results can be obtained in the manipulation of electricity in any field; and any device calculated to bring about such conditions, is worthy the attention of all men engaged in the study of electricity as applied to the various needs of mankind.

These facts are being appreciated by mechanics and electricians all over the country, as indicated by the fact that the wheels of this company are being used by 150 of the leading electric and horse car lines in the United States and Canada, and by nearly all the car builders. This company has designed wheels for special electric service, and are frequently consulted as to what is best suited for certain requirements of electrical traction.

The Consolidation.

The Edison-Thomson-Houston agreement, as published in the ELECTRICAL REVIEW last week, has been made public. There are no important changes in the terms as then presented. The agreement is dated February 9, and stocks must be deposited by April 15. The agreement becomes operative on the deposit of a majority of both stocks.

FIG. 2.—PLANT OF THE NEW YORK CAR WHEEL WORKS, BUFFALO, N. Y.

Newspaper Indictments and the Electrocution Act.

The absurd indictments pending against the editors or business managers of newspapers in New York, have been dismissed on motion of the district attorney before Judge Martine in the General Sessions. Mr. Nicoll, said, "If your Honor please, the statute upon which these indictments were founded having been repealed without reservation or saving clause, these prosecutions necessarily fall to the ground. I, therefore, recommend the dismissal of these indictments." Judge Martine granted the motion.

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There is food for the student of every branch of electricity in the REVIEW this week.

Every toiler in electrical development should be proud of his calling. He may also take commendable pride in a field that produces such an interesting and creditable publication as the Decennial Number of the ELECTRICAL REVIEW.

Mr. M. H. deYoung, editor and publisher of the San Francisco *Chronicle*, has written an article on "The Columbian World's Fair" for the current issue of the *Cosmopolitan*. This is the most comprehensive and interesting story of the Fair that has yet appeared.

It is stated that the Sixth avenue surface road in this city is likely to adopt the trolley system for motive power shortly, and the mossbacks have commenced to howl. One of our enlightened contemporaries says that "when that comes about the people will have ceased to exercise the right of suffrage and hemp will have outgrown cultivation."

Why not go further, brother, and invoke a special act of Providence?

The influence of President Huntley and the National Electric Light Association, is being felt in unexpected quarters. The daily press has been initiated to such an extent that the Buffalo *Express* rises to remark that:

The ranks of the electricians may well be swelled by the brightest young men who have a taste for science and the good gift of capacity for hard work. To such, the career of practical electrician seems to us one of the most brilliant which American opportunity anywhere offers.

The cable between Nassau, in the Bahamas, and Jupiter, Fla., just completed and opened for business, will doubtless prove of much value to Americans as well as to our island neighbors, owing to the growing intercourse which has been opening up during the last few years. These islands are now, in reality, commercial dependencies of our republic, and their practical interests are very largely dependent upon their business relations with this country. Here it is that they find their best market for their products, which will be materially enlarged by the greater facility of intercourse given by the new cable. Nassau has become a very popular Winter resort for Americans, even though it has taken a month of time for communication between New York and Nassau. The reduction of this time should materially increase the number of tourists from the States.

The growth in the business of the great electrical corporations, the Edison, Thomson-Houston and Westinghouse Companies, in the last year or two has been something enormous, and, if we mistake not, the year '92 will show even more remarkable progress. All of these companies have greatly enlarged their field of operations, and there is very little territory on this continent that is not now covered by their ever-persistent agents. The South and the West particularly have been large consumers of the products of the factories of these concerns, and the prospects of business in these sections is very promising indeed. The Thomson-Houston Company has, for some time past, been seriously considering the idea of locating a factory at the West to accommodate the trade so rapidly increasing there. These companies have not only enlarged their range of territory, but have added one after another the manufacture of the various supplies and appliances, used in the work of construction. This has brought about a greater uniformity in their character and an improvement in the average quality. Whilst this policy has seriously affected many weaker dealers in these commodities, the stronger concerns have been benefited by having the cheap, unreliable trash wiped from the field of competition. This is the age of concentration, and it can be looked for in the electrical as well as in all other industries.

ABOUT OURSELVES.

The ELECTRICAL REVIEW has passed the tenth mile-post of a successful career.

It presents to its readers in this Decennial Number an electrical feast.

The history of the REVIEW is practically a history of electricity; aside from the telegraph, all of the great industrial electrical improvements have had their chief development during its life.

It has told in its pages an interesting story of electrical progress.

It has witnessed the growth of the telephone, the electric light and electric railroads, and discussed with enthusiasm every step forward.

It has recorded the 10,000 and more inventions which have contributed to the great progress in the art.

To-day it invites its readers to feast their eyes upon the retrospect, and points out the landmarks which glow the brightest—phosphorescent with the eternal fire and genius by which they were warmed into birth.

Now that the press gag clause of the Electrocution Law of New York is out of the way, we expect soon to see the entire unwise act repealed. Already a resolution has been introduced in the Legislature for that purpose, and we heartily commend the motive. The result of the report of the first electrocution to which reporters were admitted has been to clearly show that the matter is but an experiment, a horrible experiment, upon human flesh, with no advantages apparent over the old method of hanging, indeed, with many decided disadvantages, such as the necessity for the employment of experts, the difficulty of determining the proper amount of electromotive force to be applied in each case, the numerous preliminary operations to be employed in preparing the victim, etc. Why the great State of New York should go any further in trying to solve a problem which, when solved, would not have advanced civilization one step, is difficult to understand. The law was conceived by cranks, has been carried out under the supervision, very largely, of theorists, and these would-be reformers should now be set to the right-about to employ their little minds upon subjects less revolting to public decency and modern thought.

The treatment which electric light companies in some of our large cities have received from the powers that be has been so entirely at variance with the principles of equity and justice, that it is remarkable indeed, in some cases we might say scandalous. Plants have been established in these cities with a vast outlay of capital, and that when the future of electric lighting was not so assured as now; and from the outset an unreasonable and ruinous competition with gas was fostered by those controlling street lighting contracts, notwithstanding the great mass of testimony as to the greater desirability of the electric light. It was a hard struggle, and early the hope of dividends dwindled and faded away. Then came the underground question, and, instead of awaiting the results of the experiments which the companies had early undertaken with that spirit of enterprise and progress which has characterized them throughout, they were forced into premature action which proved as unavailing and needless as it was costly, and the unfortunate companies had to foot the bills. This "stand and deliver" policy has been continued to date, and prices have been forced down even to below the cost of production by methods worthy of Chatham street of the old days; a return to gas has in some instances been used to squeeze these companies to a surrender of the last penny of profit. It has been a case of the nether millstone—on the one hand the impossibility of giving up business owing to the many interests embarked, and on the other hand an utter disregard of all that is right and just. Meanwhile, the politician flourishes as the benefactor of a community which owes so much in the improvement of the conditions of life to his defrauded victims.

THE PRESENT OFFICERS AND EXECUTIVE COMMITTEE OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

1.—C. R. Huntley, President. 2.—James 1. Ayer, First Vice-President. 3.—M. J. Francisco, Second Vice-President. 4.—Geo. F. Porter, Secretary.
5.—A. J. DeCamp. 6.—Chas. R. Faben, Jr. 7.—A. J. Corriveau. 8.—John A. Seely. 9.—H. H. Fairbanks.
10.—E. F. Peck. 11.—Frederic Nicholls. 12.—A. M. Young. 13.—M. D. Law.

THE EXECUTIVE COMMITTEE OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

BIOGRAPHICAL SKETCH OF THE CONTROLLING BOARD OF THIS PROSPEROUS ORGANIZATION.

C. R. HUNTLEY, BUFFALO, N. Y.

C. R. Huntley, president of the National Electric Light Association, is a native of the State of New York, having been born in West Winfield, Herkimer county, on October 12, 1854. He is secretary and general manager of the Brush Electric Light Company, of Buffalo. Prior to his becoming interested in electric lighting he was connected with the petroleum business, both as a producer and as a general broker. In 1888 he became secretary of the Brush Company, and a year later was made its general manager. He is a prominent member of the New York Electric Club, as well as of several other technical associations. Mr. Huntley first served as chairman of the executive committee of the National Electric Light Association, and at the Providence Convention, held last February, was elected president. His administration has been a most successful one, the semi-annual convention at Montreal being one of the most interesting and noteworthy meetings held by the Association. The finances of the Association will be turned over to his successor in a more flourishing state than ever before. Mr. Huntley is quite a young man and is extremely popular with all his associates.

JAMES I. AYER, ST. LOUIS, MO.

Mr. James I. Ayer, the first vice-president of the Association, although yet a young man, has had quite an extensive experience in the electrical field, which dates back to the time that the infant, so to speak, was in its swaddling clothes. He entered the service of the Jenney Electric Company as general agent in 1885, and served in that capacity till 1889, giving also much personal attention to the practical electrical engineering work in connection with their large business in the construction of central station plants throughout the country. In 1889 he was engaged to build what is known as the Municipal Electric Lighting and Power Company's plant, in St. Louis. Mr. Ayer severed his connection with the Jenney Company and assumed absolute charge of the construction of this station, to-day one of the largest in this country and a model in many ways. On the completion of this task, and it proved far from an easy one, he accepted the management of the company, and has since retained this important position with the most gratifying success. Mr. Ayer is a hard student and prominent in mechanical and electrical engineering circles, being a member of the American Society of Mechanical Engineers, an associate member of the American Society of Electrical Engineers and a member of the Engineers' Club, of St. Louis.

M. J. FRANCISCO, RUTLAND, VT.

Mr. M. J. Francisco, the second vice-president of the National Electric Light Association, was born at West Haven, Vt., August 5, 1835. He entered Oberlin College in 1852, and returned to Vermont in 1859. In 1863 he married a daughter of Israel Holmes, one of the founders of the well known house of Holmes, Booth & Haydens. In 1864, with the co-operation of a number of prominent men, he organized the Pennsylvania College of Trade and Finance, at Harrisburg, over which he presided until failing health compelled him to return to Vermont. Mr. Francisco is also prominently known for his connection with the insurance interests of his State, and for a famous argument which he made before the joint committee of the Senate and House on the "Valued Policy Bill." In 1876 Mr. Francisco met with an accident which compelled him to relinquish business for two years, and necessitated a voyage to Europe. In 1884 he was elected president of the Holmes & Briggs Manufacturing Company, of New York, since which time he has been closely identified with many financial and manufacturing corporations in Vermont, Connecticut and New York. He is a member of the American Institute of Electrical Engineers, the New York Electric Club, and of the New England Electric Exchange. In 1887 he was elected president of the Rutland Electric Light Company, a position which he still holds. At the convention of the National Electric Light Association, at Kansas City, he was made a member of the executive committee, and at the Providence Convention was elected second vice-president. Mr. Francisco is prominently known by his exposures of the "Fallacy of Municipal Ownership," the papers and articles he has written on the subject having given him a wide fame.

GEORGE F. PORTER, NEW YORK.

Mr. George F. Porter, the secretary of the Association, was born in Pittsburgh, Pa., March 12, 1855, and graduated from the public schools of that city in 1871. He then entered the profession of civil and mechanical engineer, which he followed until 1873. After this he engaged in the iron business until the Fall of 1875, and it was while pursuing this calling that Mr. Porter began his electrical work, as part of his duties were those of a telegraph operator. He was engaged in the railroad business until the Spring of 1887, being with the Pullman Palace Car Company and located at the Philadelphia office. Shortly afterwards, Mr. Porter again entered the iron business, remaining until January, 1883, excepting about one year, when he was in the engineering department of the Pittsburgh and Western Railroad. From 1883 until a short time ago Mr. Porter was in the carbon business, excepting about a year and a half, when he held a position in the Philadelphia office of the Westinghouse Electric Company. Mr. Porter is a charter member of the New York Electric Club. His recent appointment by President Huntley to the position of secretary of the National Electric Light Association gave great satisfaction to the electrical field, and the development of the Association during Mr. Porter's short *regime* has shown that this confidence was not misplaced.

CHARLES R. FABEN, JR., TOLEDO, O.

Mr. Charles R. Faben, Jr., of Toledo, O., has been interested in the gas industries of the country since February, 1868. He went into the employ of the Toledo Gas Light and Coke Company immediately after leaving school, and in January, 1877, assumed the duties of superintendent and engineer of that concern, positions which he still holds. He has been active in gas association matters for many years, and is a past president of the Western Gas Association, and also of the Ohio Gas Lighting Association. Mr. Faben's interest in electrical matters is very great, although his duties have been such as to prevent his activity in the electrical field being as extended as he would like. In June, 1887, when the Western Electric Light and Power Company, of Toledo, O., began operations, Mr. Faben was delegated to the general managership of the company. He still occupies the same position. He joined the National Electric Light Association at the Niagara Falls meeting in 1889, and was made a member of the executive committee of the Association at that time. At the meeting of the Association in Providence last February, Mr. Faben was again appointed a member of the executive committee.

JOHN A. SEELY, NEW YORK.

Mr. John A. Seely, who is one of our best known electrical engineers, began his electrical career with the American Union Telegraph Company in 1879. In 1880 he was engaged as electrician of the City and Suburban Telegraph Company, of Cincinnati, O. This position he filled until 1882, when he resigned to accept a place with the Metropolitan Telephone and Telegraph Company, of New York. He was engaged with this company, as general inspector, from 1882 to 1883, and was then promoted to the position of electrician, which he held until 1889. Mr. Seely resigned from the telephone business to enter the electric light field, where he has made a name for himself as an engineer of marked ability. Mr. Seely is a well known member of the New York Electric Club, and is at the present time filling the following positions: General manager of the Complete Electric Construction Company, of New York; secretary of the Heisler Electric Light Company, of Union, N. J.; secretary of the Rockaway, N. J., Electric Light Company; president of the F. M. Ricketts Cable Laying Company, of New York; president of the Seely & Taylor Manufacturing Company, of New York, and president of the Newtown Electric Light Company. In all of these organizations Mr. Seely is a stockholder to a considerable extent.

A. M. YOUNG, WATERBURY, CONN.

Mr. A. M. Young, of Waterbury, Conn., like many another famous man, began his career in electricity as a telegraph operator, at Fort Plains, N. Y., in 1870. He was transferred, from time to time, to Saratoga, Syracuse, Albany, Buffalo and New York city. In March, 1878, Mr. Young assumed the management of the Waterbury Automatic Signal Telegraph Company, which was a company organized in Waterbury, Conn., for operating the Watkins system of automatic fire alarm and telephone system. In 1883 this company was amalgamated with the Connecticut Telephone Company, of New Haven. Mr. Young continued in the management of the telephone business for that section of the State until 1888. In 1883 he organized the Connecticut Electric Company, which built an electric light plant at Waterbury, using the Thomson-Houston system of arc lighting and the Edison system of incandescent lighting. Since that time, Mr. Young has been interested in the successful organization of a large number of electric light and power plants in various parts of the country. In August, 1890, the New England Engineering Company, of Waterbury, Conn., was formed, and Mr. Young was made its president.

M. D. LAW, SCHENECTADY, N. Y.

Mr. M. D. Law, now a resident of Schenectady, N. Y., was one of the pioneers in the electrical field. His first electrical work was with the Telegraph Supply Company, of Cleveland, O. In 1877 he was sent by this company to San Francisco to do some repairing of the electric plant in the Baldwin Hotel. In 1878 the first arc light machine was sent to him there, and on September 28 of that year Mr. Law started what he states to be the first central station. In 1880 he was engaged with Mr. C. M. Rowley, of New York, and was sent to Philadelphia, where he organized the present Brush Electric Light Company, of that city. He remained with this company until 1890, when he went to Denver as superintendent of the Consolidated Company, of that city. He remained in Denver until February of the same year, when he returned East and engaged with the Edison General Electric Company, at Schenectady, where he is at the present time.

H. H. FAIRBANKS, WORCESTER, MASS.

Mr. H. H. Fairbanks was born in Worcester, Mass., and has always resided there, with the exception of about four years, which were spent in the wholesale boot and shoe business, in Boston. He received his education in the public schools of Worcester and in the Worcester Academy. He has been connected with manufacturing interests nearly all of his business life. Most of this time he was with the Worcester Corset Company, of which he was treasurer. Upon the introduction of the electric light in Worcester, in 1883, Mr. Fairbanks became much interested in it, and when the Worcester Electric Light Company was formed, he was elected treasurer and secretary of the company, and has been elected to these positions every year since. He has always had a very active part in the management of the affairs of the company, which has grown from a small beginning of 50 lights to nearly 200 arc lights and 2,500 incandescent lights. The company has had to increase its plant several times, and is now occupying the new station which was built last year, and which is considered one of the model plants of the country.

A. J. CORRIVEAU, MONTREAL, CANADA.

Although Mr. Albert J. Corriveau's connection with electrical pursuits dates back but a few years, he is one of the best known men in the business in Canada. He is of Franco-Scottish extraction, and a Canadian by birth. Mr. Corriveau is known as the pioneer of the silk industry in the Dominion. His first venture in electricity was made with the Royal Electric Company, of Montreal, for whom he acted as general agent for three years. During this time he succeeded in introducing and establishing electric light plants in many of the most important cities and towns of the Province of Quebec. Mr. Corriveau's electrical connections naturally led him into intercourse with his brethren in the same business in the United States, and it was not long before he became a member of the National Electric Light Association. He was elected a member of the executive committee, being the first Canadian to hold office in the Association. He at once realized the benefits that would be derived by bringing to Canada a convention of this Association, and accordingly he mentioned the advisability of holding a convention in Canada at the Cape May Summer meeting. The matter was settled at the Providence Convention, and last September the wonderfully successful and enjoyable meeting of the Association was held in Montreal. To Mr. Corriveau and his energy much of the success of the meeting was due. He is now president and general manager of the Canadian Electrical Construction and Supply Company, of Montreal.

FREDERIC NICHOLLS, TORONTO, CANADA.

Mr. Frederic Nicholls is managing director of the Toronto Incandescent Electric Light Company, and second vice-president and general manager of the Toronto Construction and Electrical Supply Company. He was recently elected a member of the executive committee of the National Electric Light Association, and is one of the few residents of Canada who have the interests of the electrical field at heart. Mr. Nicholls is a hard worker, and has done good missionary work for the Association among his Canadian friends.

E. F. PECK, BROOKLYN, N. Y.

Mr. E. F. Peck was born March 8, 1861, at New Britain, Conn. He graduated from the New Britain high school in 1880, and entered the employ of the Thomson-Houston Electric Company, then called the American Electric Company. Mr. Peck remained with the Thomson-Houston Company as an expert, during its various stages of development, until 1885. During this time he was engaged in constructing electric lighting plants in Boston, Fall River, Lynn, Haverhill, Mass.; Columbus and Springfield, O.; St. Louis, Mo., and Brooklyn, N. Y. Mr. Peck also had charge of the exhibitions of the Thomson-Houston Company at Boston, 1882, Cincinnati in 1883, Philadelphia in 1884, and New Orleans in 1884 and 1885. Shortly after the New Orleans exhibition, in 1885, Mr. Peck accepted the position of general superintendent of the Citizens' Electric Illuminating Company, of Brooklyn, N. Y., a position which he still holds. Mr. Peck is a prominent member of the Electric Club, of New York, and holds a position on the board of managers of that organization.

A. J. DeCAMP, PHILADELPHIA.

Mr. A. J. DeCamp, member of the Executive Committee of the National Electric Light Association, has been prominent in electric lighting circles ever since the business of supplying arc lights to customers

came into commercial prominence. One of the first to enter the lighting business, he soon became the business manager of the Brush Company of Philadelphia, and since the consolidation of the electric lighting interests of that city, has had executive charge of the powerful organization thus formed. The National Electric Light Association has had no more faithful friend than Mr. DeCamp. The second meeting of the association, held in August, 1885, was the first one attended by him. Since that time he has held several positions of responsibility and trust in the association, and has always labored earnestly for its advancement.

MR. CYRUS O. BAKER, JR.,
NEWARK, N. J.

Mr. C. O. Baker, Jr., master of transportation of the National Electric Light Association, has carefully completed plans for bringing the delegates and visitors to Buffalo over the leading railway lines. Special round trip rates were secured, and the efficiency of Mr. Baker's work will undoubtedly add greatly to the number in attendance at the Convention. Special parties will come from Chicago, Boston and other cities, and a chartered Wagner palace car train will leave New York city, February 22, at 11 A. M., carrying all attendants from New York and vicinity.

This train will be a particularly attractive one, and the day, which is a holiday (Washington's Birthday), will be spent on the road and many will go who might otherwise be unwilling to sacrifice a business day for this trip. The journey from New York city over the New York Central, which traverses the course of the beautiful Hudson, is always an interesting one even to those who travel the route daily.

It may be relied upon that the party from this city will be a pleasant and congenial one of electrical gentlemen and ladies, and with the addition of the New England attendants, who join the train at Albany, will comprise a party before which Buffalo may be expected to capitulate without terms. This train will arrive at Buffalo about 11 P. M., that day, and give all an opportunity to enjoy a good night's rest and be prepared for the duties that will follow. A portrait of Mr. Baker is presented in this issue of the REVIEW, completing the galaxy of fine-looking, wide-awake men, who constitute the working staff of the National Electric Light Association.

CONVENTION RAILROAD ARRANGEMENTS.

Mr. C. O. Baker, Jr., master of transportation for the National Electric Light Association, has issued the following circular:

NEW YORK, February 10, 1892.

The various passenger associations have granted a fare of one and one-third rate for round trip from all points east of Chicago and the Mississippi river to Buffalo. Negotiations are now pending with the Western Traffic Association for members in that territory to secure this rate. Ask the ticket agent of whom you purchase your going ticket for delegate certificate to National Electric Light Association meeting which, when properly filled in and certified, will entitle you to return for one-third regular fare.

A special vestibuled train, composed of parlor, buffet and dining cars, will leave Grand Central station, Forty-second street, New York, 11 A. M., Monday, 22d inst. (Washington's Birthday), and will make the following stops to take on delegates: Albany, 2.45 P. M. (Boston delegation joins); Utica, 5.25 P. M.; Syracuse, 7 P. M.; Rochester, 9.24 P. M.; Buffalo, 10.45 P. M. Seat checks for this train can be procured from undersigned at $2 each. Railroad tickets can be obtained from any of the New York Central Railroad offices. (Be sure you get a certificate when purchasing ticket.) Tickets will also be on sale at the Electric Club, Saturday afternoon and evening, February 20, and, for greater convenience, orders acceptable for tickets and certificates on the train can be obtained at this office upon payment of outbound fare, $9.25 each. Please make checks payable to C. O. Baker, Jr.

Very respectfully, C. O. BAKER, JR.

The International Okonite Company.

No more successful wire manufacturing company has come to the front during the past decade than the International Okonite Company, whose American offices are at 13 Park Row, New York. The formation of the international feature of this company is of comparatively recent date, but it places the company in a most advantageous position for the disposal of its products, both here and abroad. Both the English plant of the company at Manchester and the one at Passaic, N. J., have been described in the ELECTRICAL REVIEW. They are models of their kind. The management of the International Okonite Company has always been of a broad-gauged and progressive character. Under the skillful guidance of Captain W. L. Candee and his associates, the company may hope for still greater success than it has enjoyed in the past.

The National Electric Light Association.

On the 20th of December, 1884, an editorial appeared in this journal suggesting that the various electric lighting companies throughout the country meet in convention at some central point and compare notes.

The matter had been talked over, but no action taken to bring it to culmination. In several subsequent issues of the REVIEW the subject was agitated, bringing about such a popular favoring of the project that a call was made in the issue of the 17th of January, 1885, at the request of representatives of a large number of electric lighting companies, stating that a convention of delegates representing companies doing an electric lighting business in the United States and Canada would be held in Chicago on the 25th of February, 1885.

On that date at the Grand Pacific Hotel the first convention of the National Electric Light Association was called to order by William A. Hovey, of the ELECTRICAL REVIEW.

The attendance was surprisingly large, over 100 being present, representing all parts of the Union, and the deep interest taken in the proceedings augured well for the future. The following officers were elected: President, J. F. Morrison, of the Brush Company, of Baltimore; first vice-president, H. M. Cleveland, of the Schuyler Company, of Hartford; second vice-president, J. H. Yarbrough, of the Brush Company, at Nashville; third vice-president, E. R. Weeks, Kansas City; secretary and treasurer, Wm. A. Hovey, of the ELECTRICAL REVIEW.

MR. C. O. BAKER, JR., MASTER OF TRANSPORTATION, NATIONAL ELECTRIC LIGHT ASSOCIATION.

After the business of organization was finished, a number of interesting papers were read and discussed, and on the 29th the convention adjourned to meet again in July.

Thus was formed an association which since has grown steadily in strength and dignity, and the limit of whose usefulness it is now impossible to define. Fourteen conventions have been held in various important cities in the United States, and hundreds of papers on the many different subjects of interest to the practical men who compose the membership, have been read. New York, Baltimore, Detroit, Philadelphia, Boston, Pittsburgh, New York again, Chicago, Niagara Falls, Kansas City, Cape May, Providence and Montreal, have in turn been visited in the order named, and the Association has always been accorded a most enthusiastic and flattering welcome wherever it has met. At the meeting in New York, in August, 1885, Baltimore was selected as the office of the Association, where all records and archives were to be deposited; later it was removed to New York city, where it has since remained.

Meetings have been held twice each year, the annual convention in February and the semi-annual usually in August. The attendance at these meetings has steadily grown, till, at the thirteenth and fourteenth conventions, it exceeded 400 persons. The following named persons have filled the honorable position of president: J. F. Morrison, of Baltimore; S. A. Duncan, of Pittsburgh; E. R. Weeks, of Kansas City; M. J. Perry, of Providence, and C. R. Huntley, of Buffalo.

Programme of the Buffalo Convention.

Below we publish the programme that has been arranged for the Buffalo Convention of the National Electric Light Association. It is one of the best and most comprehensive programmes ever presented, and will most assuredly be of great value to every electric light man. The work of President Huntley and Secretary Porter in perfecting this instructive *menu* should be appreciated by the largest attendance yet seen at these conventions:

PROGRAMME—Tuesday, February 23, 1892.

Meeting of the Executive Committee, 9 A. M., parlor, Iroquois Hotel.

Morning meeting of the Convention, 10.30 o'clock, at Library building.

Address of Welcome by Hon. Charles F. Bishop, Mayor of Buffalo.

Address of President Charles R. Huntley, of the National Electric Light Association.

Report of Committee on Underground Conduits and Conductors, M. J. Francisco, Chairman.

AFTERNOON SESSION—Beginning at 2 o'clock.

Report of Safe Wiring, M. D. Law, Chairman.

Report of Committee World's Columbian Fair, B. E. Sunny, Chairman.

Paper by Richard Hammond, "How to Fire a Steam Boiler."

EVENING SESSION—8 o'clock.

Paper by Carl Hering, "Transmission of Power."

Discussion by William Stanley, Jr., L. B. Stillwell, H. Ward Leonard, Elihu Thomson, and others.

MORNING SESSION—Wednesday, February 24, 10 o'clock.

Paper by D. Ashworth, "The Allied Powers."

Paper by William Stanley, Jr., "The Alternating Current Motor."

Paper by Erastus Wiman, "Electric Lighting from a Financial Standpoint."

AFTERNOON SESSION—2.30 o'clock.

Paper by M. C. Sullivan, "Switchboards, their Safety and Operation."

Paper by Charles A. Schieren, "From the Tannery to the Dynamo."

Paper by Allen R. Foote, "Municipal Franchises for Quasi-Public Corporations."

MORNING SESSION—Thursday, February 25, 10 o'clock.

Paper by E. F. Peck, "Overhead Construction."

Paper by E. A. Leslie, "Operation of High-Tension Currents Underground."

Paper by J. B. Craven, "Underground Construction of Buffalo Railway Company."

AFTERNOON SESSION—2.30 o'clock.

Paper by L. B. Stillwell.
Report of Secretary and Treasurer.
Report from Executive Committee.
Election of officers.
Adjournment.

Electric Clubs and Societies.

Early in the history of commercial electrical work in this country, the desire for association in order to promote and advance electrical knowledge manifested itself, and clubs, societies and associations sprung up in different parts of the country, giving an interest to the subject which has since grown so important to the welfare of mankind. The New York Electrical Society was the pioneer and was organized in 1878, holding its meetings at the Cooper Union in this city. Prof. Van der Weyde was its first president. On its rolls will be found many names that have since become important factors in the electrical world. The Buffalo Electrical Society was formed in 1883, and it still holds an important place in the galaxy of societies of the country. Lectures are given on the subjects of the day and instruction furnished in the branches of electrical science.

On May 13, 1884, the American Institute of Electrical Engineers organized and adopted its constitution and by-laws, meeting at the club house of the American Society of Civil Engineers, in New York city. At this meeting the following officers and managers were elected: President, Norvin Green; vice-presidents, A. Graham Bell, Chas. R. Cross, Thomas A. Edison, Geo. A. Hamilton, C. H. Haskins, Franklin L. Pope; treasurer, Rowland N. Hazard; secretary, N. S. Keith. Managers: C. F. Brush, W. H. Eckert, S. D. Field, Elisha Gray, Edwin J. Houston, C. L. Hillings, Frank W. Jones, Geo. B. Prescott, W. W. Smith, W. P. Trowbridge, Theo. N. Vail and Edward Weston.

The New York Electric Club came into existence at the Astor House, New York city, on the 5th of May, 1886, and was the first electrical organization formed to foster in particular the purely social side of the gathering together of electrical men. The club had many enthusiastic supporters from the start, and it has since served as a model for numerous clubs in other parts of the country. The organization was completed at the first meeting, and the following named gentlemen were elected as officers and executive committee: President, H. C. Davis; vice-presidents, John B. Powell, O. E. Madden, Geo. L. Beetle; recording secretary, Eugene T. Lynch; corresponding secretary, Chas. W. Price; treasurer, Andrew J. Dam; custodian, H. B. Thayer. Board of managers: officers *ex officio*, Eugene F. Phillips, Hugh R. Garden, Henry C. Adams, Thomas L. Fowler, Henry D. Stanley, Willard L. Candee, Clark B. Hotchkiss, H. L. Storke, Chas. Dutton, Gen. C. H. Barney, M. W. Goodyear, Ralph W. Pope, John W. Beane, E. T. Gilliland, Geo. G. Ward, F. W. Jones, W. C. Humstone, E. A. Leslie.

Since this time the Boston Electric Club, the Chicago, Pittsburgh, Fort Wayne and other electric clubs have been formed and flourish to day, with ever increasing membership and interest in their work.

The American electrical societies and clubs have become our joy and pride. Here many advanced ideas in electrical science are first heard and discussed, and their records grow in value and importance.

Summary of Electrical Exhibitions For the Past Ten Years.

Munich Electrical Exposition, held in 1882.

Vienna International Electrical Exposition, opened August, 1883.

Philadelphia Electrical Exhibition, opened September, 1884, under the auspices of the Franklin Institute of the State of Pennsylvania for the Promotion of Mechanic Arts.

American Electrical Exhibition, opened in November, 1884, and held in the city of Boston.

The Paris International Exposition, held in Paris, 1889, and though it was not solely an electrical exhibition, the electrical features were the most striking, novel and important.

Frankfort International Electrical Exposition, held in the Fall of 1891. In connection with this exhibition were conducted the now celebrated long distance power transmission experiments between Lauffen and Frankfort.

Is Electricity Related to Nervous Force?

BY J. J. CARTY.

"Wonderful as are the laws and phenomena of electricity when made evident to us in organic or dead matter, their interest can bear scarcely any comparison with that which attaches to the same force when connected with nervous systems and with life; and, though the obscurity which for the present surrounds the subject may for the time also veil its importance, every advance in our knowledge of this mighty power in relation to inert things helps to dissipate that obscurity and to set forth more prominently the surpassing interest of this very high branch of physical philosophy. We are, indeed, but upon the threshold of what we may, without presumption, believe man is permitted to know of this matter, and the many eminent philosophers who have assisted in making this subject known have, as is very evident in their writings, felt up to the very last moment that such is the case."

Thus wrote Faraday on the eve of his experiments on the *gymnotus*, and, although 50 years have passed and mighty have been the advances in the mighty power, the obscurity still remains.

Faraday's experiments revealed but little, and the subject has since been left to charlatans and pseudo-scientists. Faraday hoped to discover some such relation between electricity and nervous force as exists between electricity and magnetism, or electricity and heat.

Priestly, as early as 1774, held that electricity and nervous force are identical. Dr. Wilson Philip, Matteucci, Prevost and Dumas all held similar views. But, nevertheless, the identity of electricity and nervous force has not been established, and there is no more absolute proof that nervous force is a manifestation of electrical energy than there is to show that the rope of a church bell is sound.

On the other hand, it has not been proved that the nervous force is not an electrical phenomenon, and thus the subject still possesses all of its original interest and importance.

How, then, can the subject be investigated? Let us see what method Faraday employed. That philosopher experimented with the *gymnotus*, or electric eel, and a large part of his work was devoted to proving that the electric current given off by that curious fish was capable of producing precisely the same effects observed with artificial sources of electricity and no others; in other words, that the shock of the *gymnotus* is an electric shock. For some reason, Faraday did not carry his experiments further, but he leaves us a suggestion which is of peculiar interest in connection with this subject. These are his words:

"Now, though I am not as yet convinced by the facts that the nervous fluid is only electricity, still I think that the agent in the nervous system may be an inorganic force; and if there be reasons for supposing that magnetism is a higher relation of force than electricity, so it may well be imagined that the nervous power may be of a still more exalted character, and yet within the reach of experiment.

"The kind of experiment I am bold enough to suggest is as follows: If a *gymnotus* or torpedo has been fatigued by frequent exertion of the electric organs, would the sending of currents of similar force to those he emits, or those of other degrees of force, either continuously or intermittently, in the same direction as those he sends forth, restore him his powers and strength more rapidly than if he were left to his natural repose?

"Would sending currents through in the contrary direction exhaust the animal rapidly?"

Nothing seems to have come of these suggestions, partly by reason of the difficulty of procuring and preserving the necessary specimens. But to study the possible electric nature of nervous force, it is not necessary to go to South America for eels. The nervous system of any animal furnishes a promising field for research, and this article will indicate by a number of remarkable analogies, a line of investigation which might in some degree serve to dissipate "the obscurity which for the present surrounds the subject."

The wonders of the human body have often been described, and similarities between its various parts and mechanism of man's own creation have been pointed out; but for a proper understanding of the present subject, it is necessary to go over them somewhat in detail.

The heart is a pump, having valves which force the blood through a system of tubes called the arteries, which ramify to the farthest parts of the body and back again through another set of tubes, the veins. These veins are full of little valves, placed about an inch apart, so as to prevent the cumulative pressure of the weight of the contained blood. The lungs act like a bellows, and in the throat is an automatic valve which closes the windpipe every time food is taken. The eye is a true *camera obscura*, and the stomach is a chemical laboratory with powers astonishingly varied. Thus the examples might be extended to the bones, which are hollow and round like our modern building columns, to give lightness with strength; hinged joints, ball and socket joints, and combinations of bones and muscles make levers of various orders.

In all of these cases it will be seen that the agencies and methods used by man himself are not simply analogous, but identical with those found in the human organism.

Now to what extent does this hold true of the nervous system? If in every other function of the human body well known methods are employed, are we not justified in expecting to find in the nervous organism a system of communication employing a force with which we are familiar, and which we ourselves have utilized in other ways?

The general similarity between a telegraph cable and a bundle of nerves is so obvious that long ago electricity was suggested as the possible agent employed, and an examination of the nerves revealed a formation likened to the conductor and insulation of electric wires. But here the investigation seems to have rested.

The analogy of the modern telephone exchange is a more striking and instructive one than is that of the telegraph system.

MR. J. J. CARTY, OF NEW YORK, A TALENTED AND PROGRESSIVE TELEPHONE ENGINEER.

In some of the highly specialized telephone systems there are two wires extending to each subscriber, one by which messages are sent from the subscriber to the central office, and the other over which the central office sends communications to the subscriber.

In the nervous system there is a perfect counterpart of this in the sensory and motor nerves. In case the finger is touched to a hot iron a message of pain is sent over the sensory nerve to the brain, which may be considered the central office of the body. Upon the receipt of this impulse at the brain a signal is transmitted along the motor nerve to the finger, which is immediately withdrawn from the iron by the proper muscle. In the case of a learner at the piano, the movement of the fingers must be directed in detail from the brain, but after much practice this work is performed automatically by a ganglion, or knot of nerves, which may be considered as a branch office of the brain.

A parallel to this is found in a telephone system when a number of subscribers at a distance from the exchange requires constant communication with each other. The business is at first handled in the main office, but after its nature is discovered a separate small office is established near the subscriber, and the main office is relieved of this work.

If the line leading to a subscriber's station is cut off at a half way point, and a signal is sent to the central office, the operator there will naturally suppose that the call comes from the subscriber's station, although connection therewith has been entirely severed. Something like this happens when a man's arm has been cut off, and the surgeon makes a bad job of it. The irritation of the ends of the nerves at the stump which formerly led to the fingers is supposed, by the central office at the brain to come from the fingers, and a sensation of pain at the fingers is produced, which is just as real as though they were attached to the body.

It is admitted that the nervous conductor is insulated so as to prevent the accidental transmission of the impulses to its fellows, and certain sheaths have been recognized as performing this function. But in such an extremely sensitive organization, one is justified in the expectation that interfering impulses might be transmitted laterally between nerves by some means not depending upon contact, as in the case of the telephone system under comparison, where a signal is transmitted inductively between wires separated by several feet of perfectly insulated sheaths.

Now, if such an action is possible, there must be some means adopted by nature to avoid it, and it is here that certain incisions and indentations of the nervous envelopes become of interest, when examined as being possible "anti-induction" appliances.

A section of one of the tin-foil covered conductors, sometimes used in telephone cables, present a striking resemblance to a section of a human nerve.

One of the coverings of the nerve, called the medullary sheath, is found to refract light strongly. This point would bear investigation in view of some experiments showing that certain manifestations of electricity are refrangible, and also in view of the fact that in a previous paper the author demonstrated the theoretical possibility of preventing telephone induction by a method of refraction.

This analogy might be greatly extended, but it is dangerous ground for one who is not a physiologist. Suffice is to say that the number and peculiar shape of the nerve coverings seem too complex to be employed simply to prevent contact.

The existence of this suspected inductive action does not depend upon the identity of electricity and nervous force, but might be a phenomenon connected with some higher form of force which it seemed to Faraday might exist.

A study of the nervous system from this new standpoint might produce important results in both physics and medicine. In any event, it furnishes a working hypothesis for attacking the problem of telepathy as stated by Professor Oliver Lodge. If it is conceivable that one nerve might act upon another without contact, why not one mind upon another without resort to the conventional methods? If it should be found that a peculiar formation is required to prevent "induction" between nerves, the simultaneous absence of that formation in two subjects would be requisite for mind reading. Touching this matter, Professor Lodge spoke as follows at the British Association last Summer, and if any apology is needed for treating such a questionable subject it will be found in his words:

"The ordinary processes of observation and experiment are establishing the truth of some phenomena not at present contemplated by science, and to which the orthodox man shuts his ears. For instance, there is the question whether it has or has not been established by direct experiment that a method of communication exists between mind and mind irrespective of the ordinary channels of consciousness and the known organs of sense, and, if so, what is the process. It can hardly be through some unknown sense organ, but it may be by some direct physical influence on the ether, or it may be in some still more subtle manner. For brevity it may be styled 'thought-transference,' though the name may turn out to be an unsuitable one after further investigation.

"Further investigation is just what is wanted. There are individual scientific men who have investigated these matters for themselves; there are others who are willing to receive evidence, who hold their minds open and their judgment in suspense; but these are only individuals. The great majority feel active hostility to these researches and a determined opposition to the reception or discussion of evidence. A few tricks at a public performance, or the artifices of some impostor, and they decline to consider the matter further. The field is the borderland of physics and psychology, the connection between life and energy, or the connection between mind and matter."

Development of the Electric Motor.

BY FRANK A. PERRET.

It is by looking backward over some definite period of time that we are enabled to realize the great advance that is continually taking place in all departments of the industrial world, and as we now turn our glance back one decade we are astonished at our own progress, and must surely feel that electrical engineering and the manufacture of dynamo-electric machinery have taken their places amongst the foremost of all progressive industries.

In the history of the decade, perhaps nothing is more marvelous than the development of the electric motor industry, which, in that time, has risen to a point where it equals in importance the electric generator industry and is everywhere found united with it, and the simultaneous growth of electrical journalism and the high standard it has attained in the same short time.

In respect to the electric motor, it seems as though the past year has shown more real improvement and progress than perhaps all the rest together. The recent investigations in the alternating current field have been of absorbing interest and give promise of great results in the near future. The demonstration of the practicability of low speed dynamo-electric machinery; the application of the same to numberless classes of work; the rapid extension of the electric railroad business, and the very great advance in popular enlightenment on the subject of electric power, have mainly been effected during the past year. For the year which has just begun I think we may predict not less, but more. High as is the standard of motors and dynamos to-day, a higher standard may and will be reached. There are many lines of thought waiting to be followed out. The collection of the current from the armature forms a subject full of interest and by no means exhausted, as many seem to suppose. I believe that the abolition of the commutator in machines for certain classes of work, and a great reduction of complexity and delicacy in the commutators that remain may be confidently looked for. An armature whose coils may be removed and exchanged in a few minutes, insulation of a much higher standard on both fields and armatures, and a still greater reduction of speed are among the desirable features which we may also hope soon to see.

The outlook for the future seems bright with hope and full of promise to the workers in this field, among whom I think there exists a more friendly feeling and fewer petty jealousies than among men in any other line of business to-day.

The Storage Battery.

BY WILLIAM BRACKEN.

The history of the storage battery is like that of all great inventions, but probably more intensified. Excessive enthusiasm at its inception, followed by disappointment, legal warfare, victory and defeat and *vice versa*, adjustment of differences, re-organization, commercial success. Such has been the experience of the storage battery in England and on the Continent. Such has been its experience in the United States, with the formidable exception that it has not yet reached the position of a paying business. It has almost reached that point, but not yet. We are told that the chief drawback to commercial success in this country has arisen from the unsettled condition of things arising from litigation and the diversion of capital toward litigation expenses instead of toward the development of the business. There is some truth in this; but, on reflection, I am disposed to think that this is not the chief cause. It is to be found in the fact that the great difficulties to be overcome in the introduction and use of storage batteries in a community unacquainted with their uses can only be surmounted by years of patient endeavor and after numerous trials and disappointments. Such was the experience of the storage battery manufacturers in England in the earlier years of their work. That work was begun in 1881, but a business was not established there on a commercial basis until 1889. Now we find them paying a six per cent. dividend on a capital stock of $2,250,000, and their business increasing at an enormous rate. We find over 60 electric launches in actual use in England and innumerable isolated plants, as well as a number of central stations, one of which, that at Chelsea, has a 10,000 light capacity.

MR. WILLIAM BRACKEN, OF NEW YORK, A PROMINENT ADVOCATE OF THE STORAGE BATTERY.

The Germans have plodded along in their characteristic fashion, but the storage battery business there has reached an extent which surpasses even England. We find a number of companies and individuals, all of high standing and with capital back of them, engaged in the manufacture and sale of storage batteries. Siemens & Halske now employ storage batteries in every new central station they erect, even in conjunction with their alternating current plants, by the aid of intermediate alternating continuous current transformers. The Accumulatoren Actien Gesellschaft, of Berlin, claim to have installed more than 1,000 lighting plants, and to have central stations in actual operation at Bremen, Darmstadt, Dessau, Lubeck, Hanover, Breslau, Stettin, Dusseldorf, Cassel, Naples, Stockholm, Vienna, Copenhagen, The Hague, Trieste and other continental cities. Another storage battery company, the German Accumulator Company, has a factory at Hargen, Westphalia, with facilities for 400 to 500 hands, and has recently started a branch factory at Vienna, with capacity for 100 hands. Thus we find, among other prominent manufacturers abroad, the Cologne Accumulator Works, Corens & Company, Berlin; the Oerlikon Works, in Switzerland; the Laurent Cely and the Atlas Accumulator Company, in France.

Much has been attempted abroad in the application of the storage battery to electric traction. Indeed, as much attention has probably been given to this as to the other uses of the storage battery; but, owing to the greater difficulties to be encountered in traction, the progress made in that department is entirely incommensurate with the efforts put forth. We find, however, two lines of storage battery cars in successful and, we are authoritatively informed, in profitable use—the one at Manchester, England, and the other at The Hague.

There are about 50,000 accumulators at present in use in the United States. I venture to predict that this figure will be doubled in less than two years. The knowledge of the many uses to which storage batteries may be put is rapidly increasing, and the intelligent handling of them when installed is becoming every day more and more assured, by reason of the large number of persons trained and being trained in electrical skill. It is almost certain that a large number of electric launches will be used on the lagoons of the Chicago Fair grounds. This is bound to give great impetus to the use of electric launches in this country. If the Metropolitan Street Railway Company at Washington make a success of their traction installation, the use of storage batteries in traction will, to a very considerable extent, be assured. A close investigation into storage battery lighting in this city, in Philadelphia and in Chicago, develops the fact that there is an almost startling economy in the employment of storage batteries in hotels and large public buildings. The use of storage batteries for phonographs and for medical purposes has increased more than 100 per cent. in the last year. The increase in railway train lighting has not been encouraging in this country, although it is making great headway abroad. The drawback here arises partially from the apathy of our people to better lighting and ventilation, and the limited depot facilities of our railways. These drawbacks will, however, soon disappear, and I look for, at a very early day, a great increase in the use of storage batteries for lighting not only trains, but also cable cars and private vehicles. Our large electric light companies, who have not yet had time to consider the economies of the storage battery, will soon see it to their advantage to employ the storage battery, if for no other reason than as a means to sell their generators and other appliances.

My conclusions, therefore, are that the storage battery will, in the very near future, realize the hopes of its former advocates, if not in the lines laid out by them, certainly in other ways.

The new cable to the Bahamas from Jupiter, Fla., was opened for business on the 5th inst. The Western Union Telegraph Company built its land line from Kissimmee to meet it. The rate charged is 35 cents per word from New York to Nassau. The new enterprise is in a great measure due to the energetic pushing of Sir Ambrose Shea, governor of the Bahamas. This cable is 230 miles in length, and was shipped from London in December last, and it was laid in a little over a fortnight.

An Electrical Pioneer—General E. S. Greeley.

The picture of General E. S. Greeley is a life-like portrait of one whose career from boyhood to middle life has been a fine illustration of the energy, enterprise and other sterling characteristics of American manhood.

His ancestors were of that sturdy stock which peopled New Hampshire, and by their industry and brain power converted its rugged ridges into sources of wealth. Like most New England boys, young Greeley inherited an aptitude for mechanism. Long before he reached his teens, he could, with his jack-knife, fashion anything he desired. When the time came for him to leave school and enter upon his life's work, he decided to be a machinist. Accordingly, he learned that trade thoroughly, and when, in 1861, the call to arms sounded, he held an important position in the repair shops of the New York and New Haven Railroad.

In the Summer of 1861, he, with Captain E. D. T. Goodyear, recruited Company C of the Tenth Connecticut Infantry, and, as first lieutenant of that company, he went out on the famous Burnside expedition to the sounds of North Carolina. In 1862, because of the death of two of the field officers of the Tenth Regiment, there were promotions from the line. The first of these was offered to the senior captain, who declined to accept it unless Governor Buckingham would commission Lieutenant Greeley to the command of his company. In his letter to the Governor, that captain said: "While Lieutenant Greeley is fifth in line of promotion, yet he is so immeasureably superior to his seniors of the same grade that I believe he will take better care of the splendid men of Company A than any other officer you could select." The commission was granted, and Greeley's subsequent military career more than justified the appointment.

MR. EUGENE F. PHILLIPS, PRESIDENT AMERICAN ELECTRICAL WORKS, PROVIDENCE, R. I., A LEADING ELECTRIC WIRE MANUFACTURER.

He passed through all the intermediate grades to colonel and was breveted brigadier-general for gallant and meritorious services; was mustered out in September, 1865, and immediately made arrangements to start the business of railway and electrical supplies with the late L. G. Tillotson.

When Mr. Tillotson died, the business passed under General Greeley's supreme control. From the beginning the firm did a great business in railroad, telegraph and telephone supplies, and it was the first house in the world to enter largely into the furnishing of electrical appliances.

To-day The E. S. Greeley & Company stands in the first rank of the trade on all these lines and has its regular customers all over the globe.

Some months since, the writer of this sketch called at the salesroom of The E. S. Greeley & Company on Dey street, and saw there several coops of carrier pigeons. A clerk, who was asked why those birds were there, replied: "They are ordered for the Sandwich Island group. There is not business enough between these islands to pay interest on the cost of laying a cable between them, but there is sufficient to pay for maintaining a carrier pigeon service, and hence this order."

General Greeley is in the prime of life. He is an indefatigable worker, cool, systematic, diligent and vigilant. He finds time to keep abreast with current thought and can converse understandingly on any matter of public concern. He has an elegant home in New Haven, Conn., where, with his wife and daughter, he dispenses a quiet, unostentatious hospitality, and where he is prominent in all political and social affairs.

GEN. E. S. GREELEY, OF NEW YORK, A PIONEER IN ELECTRICAL MANUFACTURE AND SUPPLY.

The American Electrical Works, Providence, R. I.

One of the large and prominent companies in the electrical field whose growth and development have occurred during the past decade is the American Electrical Works, whose leading spirit is Mr. Eugene F. Phillips.

Mr. Phillips commenced business in his own name in 1870 and continued until 1882, when the American Electrical Works was formed, with Eugene F. Phillips president and William H. Sawyer secretary and electrician. Mr. Sawyer went to Providence as Mr. Phillips' superintendent in 1878. The company was organized with a paid up capital of $100,000. This capitalization was increased in February, 1883, to $300,000, in July, 1885, to $365,000 and in October, 1890, to $500,000, fully paid up. The officers of the company remained the same until October, 1891, when Mr. Phillips was re-elected president, William A. Hathaway was made treasurer, while Mr. Sawyer remained secretary and electrician.

The business of the company has steadily increased from operating two braiders in 1870 to occupying two acres of land in Providence nearly covered with buildings, some of which are brick and five stories in height. The company also has a large branch factory in Montreal.

The plant of the American Electrical Works has been described from time to time in the ELECTRICAL REVIEW as improvements and additions have been made to it. Much of the success of this company is due to the high character and integrity of its president, Mr. Phillips, than whom no one stands higher in the electrical field. Mr. Phillips is a very genial gentleman in his personal character, and nearly every member of the electrical fraternity has had an opportunity, at one time or another, of enjoying his hospitality.

BOOK REVIEW.

THE ELECTRIC RAILWAY IN THEORY AND PRACTICE, O. T. Crosby and Louis Bell.

This is a work which is sure to take a leading place in the electrical literature of to-day, possessing, as it does, so many claims to the careful attention of all who are interested in the subject of electric railways. It treats this very important branch of the electrical art with a thoroughness and in so practical a manner, bringing the matter up to date, that the railway manager will find it an excellent book of reference, whilst the general reader cannot fail to be pleased with the plain, concise and complete way in which the subject is handled. The authors not only know how to compile a book, but they have also given us something which fills a want and is of genuine value.

TEN YEARS WITH THE TELEPHONE.

The Leading Elements of Progress Which Have Made the Present Extension of the System Possible.

BY JOHN A. BARRETT, NEW YORK.

Nothing marks this decade with more momentous interest than the growth of the telephone business, and nothing displays with more completeness the all-compelling resources of the American mind, in reducing science to domestic service, both by practical invention and by commercial management.

In 1876, the speaking telephone, however long its gestation, was brought forth at the hands of Mr. Bell, and was started, a complete, if yet an infantile, organism, upon its worldly career. The first five or six years of its life it naturally spent in getting upon its feet. These early toddlings and tumblings, looked back upon from the adult stage, are, no doubt, ludicrous and mirth-provoking in the extreme; but they were the serious and nervy exhibitions of the courage of childhood, and a necessary preliminary to the broad and strong development of the following years.

In 1882, however, a more settled character and firm purpose had been established, and a promise of splendid future capacities was held out to those who could rightly read it.

These ten years of the REVIEW's life really comprise the period during which the telephone has come to a realization of its powers, and has steadily and inevitably pursued its way into its position as an acknowledged necessity of modern society.

When the REVIEW first came upon the field, the telephone exchange system, which has at the present so interlaced itself with our commercial and social life, as to be not merely the adornment, but a part of the very body and structure through which that life is expanding, was then in the crudest possible state, and occupying very minor relations with the community. Its importance, as the method by which the telephone was to become the means of universal and ready intercommunication, was nevertheless beginning to be realized, and "central offices" were already established in the larger cities.

In respect to the constitution of the exchange, the conditions of the switchboard problems had hardly yet begun to be stated, to say nothing of any practical solution of them. A spirited contest was being waged between "plug" boards and "cord" boards, with the odds rather in favor of the former. The keynote to the plug board system is, that the total number of subscribers is divided in the board into small groups or squares. The members of each square are directly communicable with each other under the hand of a single operator; but a connection between members of separate groups requires the use of an intermediate trunk line and two operators. The advocacy of such a method of handling subscribers, however serviceable it may have been in small offices, against the cord switchboard, the germ of the great multiple boards of the present day, shows how little was conceived of such a thing, as the possibility of having 5,000 subscribers' lines centralized in one exchange office, under such conditions that, by three or four simple movements of a single operator, any calling subscriber may be immediately and directly connected with any other one of the whole 5,000.

It is mere natural history that the cord board should gain its way over such a competitor.

Another cramping feature of early exchange methods which has fallen before the enlarged capabilities of the multiple cord board, is the division of subscribers into limited exchange districts, with a local switchboard in each district, and trunk lines patching the separate pieces into something intended to be a united body. The question of distance from a central point is now about the only one, within a number of 5,000 or 6,000 subscribers at any rate, which determines the division of the local body into several districts. The degree to which this change has advanced the comfort, convenience, and value of the service, both for subscribers and the operating companies, can only be vividly appreciated by considering a return to the lameness and distress of the old method.

Individual calls, also, and all the ingenious and varied devices by which party circuits were intended to be made an important part of exchange work, have been found to be floating trifles upon the great stream of urban business, and have been mainly relegated to the cheaper grade of trunk lines and to the modest requirements of village work, where they do still perform serviceable functions. But even there the machinery, the clock work, the synchronous vibrations, the intricate switches, have commonly been discarded, and a simple one-two-three-four push of the call button indicates to all the subscribers within hearing which one is wanted.

But there is, perhaps, no more striking illustration of the gradual evolution of a need and its following fulfillment than has been represented in the development of the cable problem in its relations to the underground system of telephone lines, and its reluctant yielding to the persistent endeavors which have been made upon it. Six years ago the richest telephone company in the country stood aghast at the prospective expense and the anticipated difficulties of putting its wires under the pavement. To-day, though the expense was not over-estimated, the difficulties have been met and vanquished, so far as they were seriously obstructive to local work, and in the place of resisting reasonable requirements in this direction, there are now no stronger advocates and promoters of underground wires than the telephone companies themselves.

On the item of expense, elements of excessive cost, which amounted to an almost complete prohibition a few years ago, have steadily been subjected to control and reduction, so that, while it still requires a large initial expenditure to substitute underground for overhead lines, yet such a substitution is practicable where the conditions make it sufficiently desirable.

Added to this have come a somewhat slowly acquired experience in handling and installing this rather delicate type of cable, so as to avoid mechanical injury and special liability to disorder, and a now pretty firmly established confidence, based upon annually augmenting history, in the reliability and permanence of lead incased conductors. There is nothing known in the arts, excepting lead covered cables, which would, as a mere matter of cost, make the present extension of underground lines practicable, and, considering the vast risks at stake and the untried nature of the conditions, the work has been prosecuted with a courageous and progressive spirit.

But, aside from the mechanical requirements of low cost and long life, there are two radical features bearing upon the electrical efficiency of the conductors for telephone use, which, remaining in their condition of 10 years ago, would have absolutely debarred through them the conduct of anything approaching the modern service, either in quality or volume.

Of these two features, at the beginning the most obvious, and the one most disturbing to local service, was the inductive interference between different lines simultaneously in use in the same cable. Amongst the early practices meeting with general favor in the construction of cable cores, was to bunch together the largest possible number of exceedingly small conductors with thin separating coverings, and to let them mix and mingle with each other indiscriminately throughout the length of the cable. Such conductors were distinguished both by high resistance and high static capacity, and when the attempt was made to extend somewhat the length of lines so arranged, an early halt was called, both by the annoyances of interference between subscribers and by the absolute limitations of retardation.

In those early days of cables, as similarly occurs in historical experiences generally, diligent search was made for medicine which, allowing the conditions to remain, would cure the evil; and nostrums beyond number were offered and employed for killing the induction microbe by poison without necessitating the removal of its habitat. It has taken the social world centuries partially to learn that the best way to cure disease is to avoid the conditions favorable to it; the telephone companies have applied the lesson to cables within a few years. We hear no more of induction killers, and expect them no more. Such medicine, if it ever killed the troublesome germ, always killed the patient with it.

Interference, such as introduces the slightest objectionable disturbance between subscribers, simply cannot exist in properly disposed metallic circuits; and, whether with grounded or metallic circuits, both interference and retardation are to be effectually reduced by adopting a proper relation between the conductivity and static capacity of the conductors forming the respective circuits; that is, between the size of the wire and the thickness and inductive nature of its covering.

This in general terms defines exactly the progress which has been made in adapting cables to perform satisfactorily the telephone service.

On account of the redoubled expense of metallic circuits, it is still desirable to carry on as much business as possible through single conductors with ground return; and, owing to the comparatively insignificant static capacity existing in the cables of latest design, an unexpectedly large proportion of local work can be thus performed with entire satisfaction.

Retardation has been so far reduced that it does not form any material limitation to the length of cable line within the limits of any single city; while the metallic circuit offers an unfailing and absolute resource against interference, where the quality and value of the service warrants the extra expense.

The special means by which the static capacity has been so largely reduced are an increase in the thickness of the separating medium between the wires, the employment of manilla paper in the place of the formerly universal cotton wrappings, and the retention of as much dry air as possible throughout the insulating spaces. By the use of paper and dry air in the place of cotton with wax filling, the specific inductive capacity of cables has been, within the last three years, reduced fully 50 per cent. from the former conditions.

To one standing at the threshold of this decade of the telephone, and, while familiar with its initial acquisitions and purposes, looking forward to a vision of its matured accomplishments, the single feature which would attract attention above all others as the concrete epitome of telephone progress, is the "long distance" system, stretching its vast frame to compass and knit together the length and breadth of this land. The ultimate purpose and destiny of this system must be to put the remotest sections of the United States, at least, upon speaking terms with each other.

But it will be sufficient for the present purpose to glance briefly at what has already been achieved as a beginning of this work, and what are the chief conditions of the present stage of successful progress.

In 1882 it was commonly regarded that lines from 50 to 100 miles long, if managed according to the best lights of the time, and with considerable patience as to the uncertainty of the results, were yet worth trying to do business over. In 1892, to state a fact well within the outside limit, daily and continuous service is being furnished between New York city and Buffalo, a distance of nearly 500 miles, with promptness and satisfaction fully equal to the best capabilities of any purely local exchange.

The same is true from New York as a common center to Boston and Portland, to Philadelphia, Baltimore and Washington, to Harrisburg and Pittsburgh, and between intermediate points, while lines are nearly completed and business will soon be opened from New York city, through Pittsburgh, to Cleveland, Ohio, a distance of nearly 650 miles. The character of this service is not such as taxes the patience or calls for special effort; but the manifold conditions of the problem have been so far perfected, that ordinary conversation upon the most miscellaneous topics may be carried on with readiness and comfort, from New York to the farthest of the cities reached by the long distance lines. And from tests proving the large additional powers already present in the system, it may be predicted with great assurance, that one of the features of the Columbian Fair next year will be direct telephoning between New York and Chicago.

It will be interesting to state concisely the leading means by which such a result has been reached. These elements are severally so essential, each in its place, that they should in justice be arranged in a round-robin, instead of in a list with a first and a last. No one step has accomplished the journey, and no one could be left out without falling far short of the end.

So far as regards the electrical conditions, it is obvious that the lines must be of the best conductivity, and the transmitters of the greatest power, while disturbing influences must be entirely removed, and retardation reduced as much as is practicable. The fulfillment of these requirements furnishes really the whole ground work of long distance telephony.

The invention of hard drawn copper wire, a product which, without diminishing the original conductivity, imparts to copper the necessary tensile strength for sustaining its own weight in the span from pole to pole, carried the question, as to the metal to be employed for the lines, to a final and perfect answer at one stage.

The growth of the long distance transmitter has been more gradual. Ten years ago the Hunnings granular carbon transmitter would, no doubt, have rendered admirable service up to a distance of 300 or 400 miles, with the other conditions in their present state of perfection. From that time to this the most promising course of development has been in minor improvements and details embodying the Hunnings principle; and there has been no considerable pause in the steady increase in the powers of this beautiful instrument, until to-day it certainly is able to reach from New York to Chicago over such lines as are now being built, with no admission that the limit has yet been reached.

As to audible disturbances entering upon the lines and tending to obscure the distinctness of the transmission, these were discovered to arise from two sources. In the case of a single overhead line running across the country from one city to another, especially where heavy electric light and power and telegraph operations are prevalent, the telephone circuit being completed by a return through the ground, a rattling and rumbling produced in the receiver by so-called earth currents, or by induction from remote and powerful influences, will drown the satisfactory communication of speech within comparatively inconsiderable distances. If without contact with the ground the telephone circuit is completed by a parallel return wire, all perceptible earth disturbances will be entirely avoided; and if the two branches of the circuit are not too widely separated from each other, the inductive effects from distant lines of other electric systems will be reduced to a point where they cease to be troublesome.

With the clearing of the line from these overwhelming noises by means of the simple metallic circuit, and the attempt to operate simultaneously several such lines running parallel with each other, the increased power of the transmitter and the entire freedom from other distracting sounds brought out an unexpectedly exaggerated difficulty. It was found that the conversation passing upon one circuit was so distinctly audible upon all neighboring and parallel metallic

circuits, as to limit seriously any important extension of the service under such conditions.

The means finally employed for successfully removing this difficulty do not constitute an "induction killer" in the sense of being an appliance for attempting to sift out and destroy the disturbing effects, after they have actually begun to be propagated in the line. The long distance lines are arranged upon a system of transpositions, by which the two branches of each individual circuit are so interchanged in position through successive stages of their length, that each complete circuit is rendered practically neutral to the influences of the inductive field created by any one or any number of the other circuits which may at any time be in operation.

The great value of this protective principle lies in the fact that it effectually accomplishes its primary purpose without, in the slightest degree, impeding the direct transmission of speech, or introducing other secondary conditions unfavorable to the service of the line. The absolute nature of the requirements, and the completeness with which they are fulfilled, gives this method its position as one of the essential features of the long distance system.

Much has been done in minor ways to reduce the retardation, which is a great burden to all telephoning, whether it arises from static capacity of circuits or from self-induction and electro-magnetic sluggishness. The employment of copper conductors in the place of iron or steel does its large share of this good work. The wider separation of conductors, both in pole-lines and in cables, and the better selection of cable material, and the removal of all unnecessary electro-magnets from the working circuit, appear to have carried the matter beyond the demands of strictly local service.

Retardation, however, will always remain as a limiting function in long distance telephoning and a barrier continually inviting attack in clearing the way to further extension of the service.

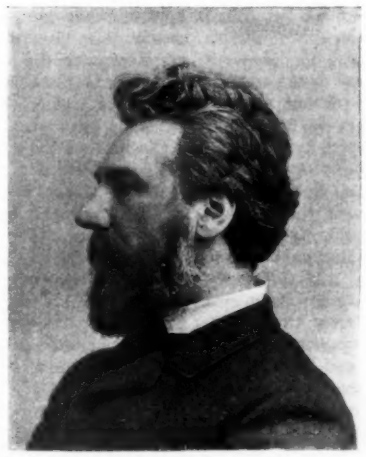
It is to be noted that here are mentioned only a few of the more striking features of telephone progress in its mechanical and electrical elements, and while all these, and all the multitude of accessories which contribute to the concrete result now presented to the public in its daily service, unite together so harmoniously as almost to sink the individuality of each, it is altogether impossible, even for those who have traveled day by day every step of the journey, to recall the length of the way, or to count the incidents and obstructions which have delayed and burdened the march. It is not in human nature to reproduce in the mind by a review, however minute and faithful, of what has been done, the same sensation of admiration and marvel, as would have been occasioned by a prevision of the same facts as something about to be accomplished.

Mr. E. J. Hall, Jr., of New York, Vice-President and General Manager of the American Telephone and Telegraph Company.

Some epigrammatic expressions are required to startle us into a keen sense of great events which have been daily evolving at our elbow. Twenty years ago we had no speaking telephone; 10 years ago a beginning had been made towards introducing the telephone as an established element of modern life. To-day let each one represent to himself what would be the probable effect upon commercial and social existence of cutting off the telephone from use, or of abating any considerable degree of its present serviceableness.

Ten years ago the telephone could have been obliterated and passed over to the land of dreams without tearing very hard at the roots of business and pleasure. To-day it would take ten years of backward growth to re-adjust the conditions under which the possibility of such a withdrawal could be conceived.

These rousing statistical propositions could be multiplied beyond any allowable limit; but we must pass to a climax and close the list for the present. It is now possible, sitting in the Electrical Review office, in New York city, to have direct telephonic connection, over local and long distance lines, with towns and cities within a radius of 500 miles, whose grand total of active telephone subscribers aggregates over 100,000, and whose combined population is fully 30,000,000; whereas, in describing an occurrence in 1875, Mr. Bell says: "I uttered the sentence, 'Do you understand what I say?' into the telephone placed in the lecture hall. To my delight an answer was returned through the instrument itself, and I heard the sentence, 'Yes, I understand you perfectly.'" And Sir William Thomson reports, in 1876, "With my ear pressed against this disk I heard it speak distinctly several sentences. I need scarcely say I was astonished and delighted."



Prof. Alexander Graham Bell, of Washington, the Inventor of the Telephone.

In 1882 people had not yet thrown off their astonishment and delight at the "greatest marvel of the electric telegraph." 1892 has become so staled with marvels that the interest it deserves will hardly be excited by the statement that the Improvements in the Art of Telephony, if summed up and properly accredited would supply a fair companion piece to the grandeur and honor of the Original Invention.

The success of the existing electric railway in London has given an impetus to the movement for locomotion of a similar kind. For consideration during the forthcoming session of Parliament there are no fewer than five bills, which propose either the construction of new electric railways or the extension of lines already authorized.

H. E. Willoughby, electrician of the West End Railway, of Boston, has invented a device to remove ice from trolley wires. It consists of an arrangement in which there are two small brooms, heavy and peculiarly made, which are constructed to fit into the trolley arms in such a way that they sweep the wires just in advance of the trolley. It is said to work well.

The Aluminum Brass and Bronze Company is making some torpedoes for the Government at a price of $5,000 each. A triple-expansion engine in the rear drives the torpedo through the water; it is of 50 horse-power and very compact. The casting, which is made of aluminum, cannot corrode and may remain in the tube for an indefinite time. When the torpedo strikes the water several valves are opened and the engine is started. The torpedo has a speed of 24 miles an hour.

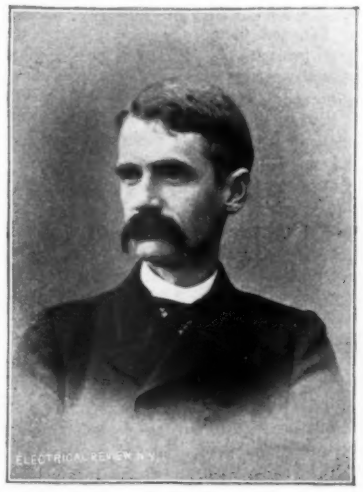
A Telephonic Trio.

The Review presents in this issue likenesses of Prof. Alexander Graham Bell, Edward J. Hall, Jr., and William Dunlap Sargent as representing three men prominent in the invention, development and management of telephonic interests. The array of bright, keen intellects, that have earnestly toiled in this branch of electrical progress is too large to present here, but it gives us extreme pleasure to present in this historical number of the Electrical Review likenesses of the three gentlemen named.

The right of Prof. Alexander Graham Bell to the honor of being the inventor of the telephone is to-day undisputed, having been passed upon by the highest authority that we have, the United States Supreme Court. The history of this invention, the closely contested legal fight and its recent grant to Professor Bell, are facts all known to the public.

In Mr. Edward J. Hall, Jr., the vice-president and general manager of the American Telephone and Telegraph Company, is typified the progressive, alert, yet careful student of the telephone and its future, both electrically and commercially considered. To him more than to any one else, the Review thinks, is to be accorded praise for the phenomenal strides made by the long distance telephone, which has now brought within, we might say, whispering distance 25,000,000 or 30,000,000 of people centering around Manhattan Island.

Mr. Sargent is one of the pioneers in the telephone field. Entering it from the domain of the telegraph key, in him is combined the well-equipped electrician with the successful manager of the commercial interests of the telephone company. Ex-president of the National Telephone Exchange Association and vice-president and general manager of the New York and New Jersey Telephone Company, with headquarters in Brooklyn, Mr. Sargent is regarded by every one familiar with the work that has been done in this field as one of the most capable and most progressive of telephone men.



Mr. W. D. Sargent, of Brooklyn, Vice-President and General Manager of the New York and New Jersey Telephone Company.

We would like to record here a few of the names of men who have been active in telephone circles during the past decade. Among these we should mention Mr. Forbes, Mr. Hudson and Mr. Driver; Theo. N. Vail, O. E. Madden, E. T. Gilliland—one of the ablest electricians of the day—M. F. Tyler, Chas. Williams, Capt. Geo. N. Stone, W. W. Smith, D. H. Louderback, Geo. L. Phillips (deceased), H. L. Storke, Thos. B. Doolittle, John J. Carty, Chas. Wilson, Prof. Haskins, A. S. Hibbard, F. A. Pickernell, Jasper N. Keller, Frank G. Beach.

The building of a motor line between Spearfish and Lead, S. D., is being discussed.

The Sixth Avenue horse car line in New York will, it is stated, soon contract for an electric trolley system to replace horses for motive power.

Early Telephone History.

In the Winter of '76 and early part of '77 the newspapers contained much about the new invention called a telephone, and most of it was written in a vein describing the telephone as a curiosity and a toy. In the month of April, 1877, George H. Coe, manager of Skiff's Opera House, and W. J. Howey, an operator in the Atlantic and Pacific Telegraph Company, joined in an endeavor to get Professor Bell to lecture on the telephone at the opera house. They were successful in arranging an elaborate programme for the evening of April, 27, 1877. Professor Bell lectured at the opera house while Frederick A. Gower, Bell's special agent, lectured in Hartford. Both places were connected by telephone over a telegraph wire loaned for the occasion by the Atlantic and Pacific Company. In addition there was an electrical and telephonic communication with an organ in Middletown which was under the supervision of Thomas A. Watson, an electrician for Professor Bell. The connections and other work incidental to the completeness of the mechanical part of the lecture were under the supervision of George W. Coy, manager of the Atlantic and Pacific Company. The lecture was not a financial success, though it created no little interest among those who did attend. The talking between Professor Bell and Mr. Gower did not work very well. A strong battery was placed on the wire, and occasionally faint sounds could be heard over it, and words were not very intelligible. During the evening, President Porter, of Yale College, who was on the stage together with other Yale professors and other celebrities, tried to talk with General Hawley in Hartford, but they failed. There was a telegraphic communication between the two theaters so that in case the telephone should not work they would not be groping absolutely in the dark. The instrument was resorted to frequently. The best communication between Hartford and New Haven was obtained by sending the Morse telegraph code through the telephone.

But most successful of all was the organ playing at Middletown. This could be heard distinctly over the 'phone. The next day Professor Bell and Mr. Coy had a long talk about the telephone. It was then seen that Mr. Bell's idea of putting the telephone to use was in his lectures to the public. He expected to make his money out of the venture in this way. He had no idea of establishing a central system of exchange; in fact, he said it could never be done, because it would be necessary at all times to have the wires a good deal apart from each other. The idea of conducting the wires into a switchboard he did not consider feasible. All the men of the Atlantic and Pacific Company were enthusiastic over the telephone, and Professor Bell promised to give Mr. Coy the agency for New Haven.

But in the next few days announcement was made that the Western Union Telegraph and the Bell Company had united, and the agency was given to J. Murray Fairchild, manager of the Western Union local office. He held it from May to September, 1877, when the Western Union dropped the Bell and took up the Phelps' telephone. Mr. Coy took the agency and worked up the central office system, which was fully described in the *Register's* last article on the subject.

Professor Bell did not linger long in his lecture tour. The lectures, while interesting to a few, were not so to the general public, and besides the expense of arranging wires, etc., was very great.—*New Haven Register*.

Electrical Advertising.

BY WM. H. McKINLOCK.

I do not feel that I can add one "jot or tittle" to what has been said in your columns about newspaper advertising. Since, however, you have asked me to "write something," the courtesy of the request impels me to comply, no matter if I do not say anything.

Newspaper advertising undoubtedly pays the publisher as well as the advertiser. Without any practical experience from the publisher's standpoint, I have noted the substantial increase in the number of journals from time to time and their well-patronized columns, the same advertisers, with a few exceptions, appearing in all, new and old, circulation or no circulation, without discrimination, evidencing a liberality and, I might say, profligacy of expenditure in the use of printers' ink, nowhere to be found outside of the electrical field.

WM. H. McKINLOCK, OF CHICAGO—A LEADING ELECTRICAL MANUFACTURER AND DEALER.

From the advertiser's point of view in dealing with the newspapers, I believe it a good plan to endeavor, in so far as practicable, to get what you pay for, and there should be a consanguinity of interests between the publisher and the advertiser to make this feature easily apparent.

It does not seem to me that to place a card in half a dozen journals, all intended for the same possible customer, is an economical method of getting business, or the most successful plan of advertising. To reach the maximum number of consumers of your wares with the minimum of expenditure is the *desideratum*, and how best to do this is often perplexing.

We have tried in the conduct of this very important branch of our business to select the leading mediums for our cards, choosing a fixed space, thus assuring stability of location to our name, which we believe is of some advantage. The announcements from time to time should be honest, practical and progressive, and by careful attention to these elements you can come to speak to your customers almost as surely as if through direct personal correspondence.

To a business of such diversified interests as ours, we can almost tell what "line" we are advertising by reference to our sales-book alone, and in some measure, therefore we can testify that advertising does pay.

The Wilmington, Del., City Electric Light Company has declared a semi-annual dividend of six per cent.

Sixteen hundred dollars was appropriated the other day for a plant for lighting the State prison at Trenton, N. J.

The latest rumor is to the effect that the Standard Oil Company or several of its millionaires, are preparing to organize a telephone company to compete with the Metropolitan Telephone and Telegraph Company, of New York city. This is to take place when the original Bell patents expire in 1893.

Hon. Gardiner C. Sims, of Providence, R. I.

Hon. Gardiner C. Sims, one of the World's Fair Commissioners from the State of Rhode Island, and general manager of the Armington & Sims Engine Company, of Providence, is one of the most prominently known men in the electrical field. He was born at Niagara Falls, N. Y., July 31, 1845. Mr. Sims acquired a common school education, and apprenticed himself to the machinist's trade for four years, which were faithfully served at the locomotive shops of the New York Central Railroad, at West Albany. Mr. Sims was a draughtsman for three years in the engineer department of the Navy Yard, Brooklyn. While occupying the position of superintendent of the J. C. Hoadley Engine Works, Lawrence, Mass., Mr. Sims met Mr. Pardon Armington, also a machinist and draughtsman. A partnership was formed and these two machinists devoted themselves to experimental work, hoping to discover a machine that would permit of the economical use of steam by simple devices.

Armington & Sims were the first to design and build a commercially successful high speed engine in direct opposition to former engineering practice and precedent.

Mr. Sims was also engaged with Thos. A. Edison in his early experiments at Menlo Park, and at the Edison Machine Works in Goerck street, New York.

Armington & Sims have now built over 3,000 engines, ranging from 15 to 1,000 horse-power, most of them being used for electric railway, lighting and power plants.

Mr. Sims is general manager of the Armington & Sims Engine Company; president of the George W. Stafford Manufacturing Company, a corporation engaged in the manufacture of textile machinery; and vice-president and consulting engineer of the Sims-Edison Electric Torpedo Company, New York. He is associated in the direction of banking and other business enterprises. He spent eight months at the Centennial Exposition in 1876, and was appointed Democratic Commissioner from the State of Rhode Island to the World's Columbian Exposition, to be held in Chicago in 1893. His prominence in mechanical and electrical matters secured for him the tender of the chairmanship of the Exposition Committee on Electricity, Electrical and Pneumatic Appliances, as well as membership of the committees on machinery and transportation. He has never held a public office of any kind, and has no political aspirations. His life has been devoted to mechanical pursuits and he is very fond of his calling.

He is married, having a wife and two sons. He is a life member of the American Society of Mechanical Engineers, American Society of Naval Engineers, National Electric Light Association and the Stationary Engineers' Association of Rhode Island.

HON. GARDINER C. SIMS—A PROMINENT ENGINE MANUFACTURER AND CHAIRMAN OF THE COMMITTEE ON ELECTRICITY OF THE WORLD'S FAIR.

Ten Years of Electric Light and Power in Minneapolis.

W. E. J. Deming, electrical inspector for the city of Minneapolis, Minn., recently published a short history of the progress made in that city during the past 10 years in the use of electricity for lighting, motive power, etc. It shows a remarkable growth, and is well worth the reading:

"The first electric light in Minneapolis was an arc light, run from a small Brush plant in the Pillsbury 'A' mill, and was started December 24, 1881. This was followed by a 10-light United States (Weston) plant in the Big Boston clothing store, old Academy of Music, March 31, 1882. It is a singular fact that the local newspapers made no mention of these lights at tl is time.

"The first isolated incandescent plant was a United States (Weston), located in the Pillsbury 'A' mill in January, 1884. At the present time there are seven isolated arc plants, running 380 lights, and 70 isolated incandescent plants running 22,110 lights. The above includes 3,025 multiple series lights run by the street railway company.

"In 1883–4 a few incandescent lights were run from storage batteries charged from central station, but this soon proved a failure and they were abandoned. Prior to 1887 the only incandescent lights run from central station were a few scattered groups of series multiple lights run on arc light circuits. About this time the furnishing current for incandescent lighting for commercial purposes became an established fact, and at the present time there are 27,822 incandescent lights running from central stations, not including street railway lights.

"Electricity as a motive power was used to but a small extent in Minneapolis previous to 1890. At the present time there are 575 horse-power of motors in use, exclusive of the street railway and small fan and dental motors. The street railway company has 6,500 horse-power of motors in use, and this makes a total of 7,075 horse-power.

"There are 1,803 arc lights running from central stations. Electric heating is in its infancy, and is not yet a perfect success, though about eight horse-power of current are used for this purpose here, chiefly in laundries, hat stores and clothing factories.

"The total business of furnishing electricity in Minneapolis for light, heat and power may be summed up as follows:

Isolated arc lights	380
Central station arcs	1,803
Isolated incandescents	22,110
Central station incandescents	27,822
Total lamps	49,932
Horse-power of motors	7,075
Horse-power electro heaters	8

"If the entire business in the city were reduced to incandescent lighting it would amount to 164,989 sixteen candle-power lamps."

The Telegraph and Telephone.

BY GEO. A. HAMILTON.

Modern civilization has introduced into daily life many wonderful things, but among them all few surpass the telegraph in benefits to man.

The telephone may, indeed, lay claim to more of the truly marvelous in the transmission of speech between widely separated places, but its limitations are much sooner reached and its benefits consequently far more restricted. Across the continent or beneath the ocean to distant lands beyond,

GEORGE A. HAMILTON, OF NEW YORK—AN ABLE TELEGRAPH ENGINEER, FORMERLY ELECTRICIAN OF THE WESTERN UNION TELEGRPH COMPANY, NOW WITH THE WESTERN ELECTRIC COMPANY.

the telegraph has domain. The telephone, at best, is confined to a few hundred miles of land line. This difference, as regards range of usefulness, though strongly marked, is not surprising when one considers the extreme simplicity of the telegraph, and the varied complications associated with the telephone. The dot and the dash, or the equally simple positive and negative impulses, alone or in combination, and repeated at low frequencies, serve all general telegraphic purposes.

With the telephone, on the other hand, in order that the most satisfactory results may be obtained, all of the voice characteristics must be reproduced. This means, of course, the transmission of hundreds, or even thousands, of impulses per second, and all too, in such a way that their relative association and magnitudes remain unchanged. Unfortunately, with the telephone, this is not realized in practice if the line possesses considerable capacity, toward which end there is an invariable tendency as it is lengthened out. It is then found that those impulses which occur with the greatest frequency are the first to fail at the receiving end of the line. Then follow in order those of other and decreasing frequencies, until, finally, if the capacity is very great, no recognizable signal reaches the receiving end at all. The capacity, in effect, practically shunts out the receiver. It is this, and this alone, that leaves so little hope for the realization of transatlantic telephony, the dream at one time of many enthusiastic inventors.

GENERAL NOTES.

Salem, Mass., has established the office of city electrician. He will have charge of all electric wires.

The Edison General Electric Company has established an electrical supply depot at Springfield, Mass., for western New England. Mr. E. Abbott Todd has charge of this office. This company has two other depots in New England, one at Portland, the other in Boston.

One of the discharged linemen of the United States Electric Light Company, of New York city, was captured the other day in the act of cutting that company's circuits and was held for trial. The damage resulting from his revengeful exploits, it is claimed, reach the figure of something like $500.

The Problem of Trans-Atlantic Telephony Solved.

BY GERMANICUS.

The philosophical society of the neighboring town of Bladensburg having added to its rooms an electric museum on the style of the "Urama" in Berlin, and wishing to celebrate its opening by a conversazione, had invited me to present on this occasion a

THOMAS A. EDISON, ORANGE, N. J.

paper on the subject, "Is affinity between molecules possible without polarization?"

On the day appointed I had carefully revised my manuscript and, anticipating a lively informal discussion, I had spent the remaining hours of the afternoon in studying Maxwell's treatise on "Atoms" in the "Encyclopedia Britannica," carefully noting down those arguments which seemed to fortify my own views with reference to the subject.

I then hastily dressed, swallowed a glass of strong milk-punch and, lighting a cigar, awaited the carriage, which was to take me to the place of meeting three-quarters of an hour away.

In a short time the servant announced the cabman. I entered the vehicle and soon the monotonous roll of the wheels on the smooth country road enveloped my senses with its soothing influence. I lazily reclined on the soft carriage pillows trying to catch a short rest as a preparation for the evening's work. But it seemed as of no use, although I shut my eyes and tried to banish from my mind the mass of intricate equations through which I had waded for several hours previous.

The carriage seemed to make but slow headway, but presently it stopped and I alighted and entered a new portal to the left of the main entrance which, as I had been informed, led directly to the museum which I meant to inspect before going to the lecture hall.

Upon entering, a curious sight greeted my eyes. Large numbers of instruments, such as I had never beheld or heard of, stood on the tables and shelves. A couple of overseers in most outlandish costumes patroled the floor. Now and then a telephone, provided with a small funnel, would emit a soft song or an orchestral piece, and, most strange of all, the light in the rooms seemed to emanate from large glass tubes distributed along the walls in shapely forms and which were filled with sunlight glow, although neither filament nor arc carbons were visible.

In a corner of the hall I noticed the inscription "Electric Microscope," and entering the small door underneath I suddenly found myself in a very cool grotto, revealing under a dim light the large eyepiece of an enormous looking microscope.

Seated beside the instrument I noticed another one of those strangely clad overseers, who beckoned me to look into the eyepiece.

"This," he said (evidently taking me for a visitor from the country desiring to be instructed), "is an electric microscope. The object lens consists of a disk of frozen iodide of iron solution surrounded by a coil of wire, through which flows a current of 600 amperes, which the electric furnace in the basement furnishes.

"The electro-magnetic field produced by this coil in the frozen disk produces a perfect lens effect, but with the necessary parabolic correction for very large magnifying effects. A continuous spray of liquid carbonic acid not only keeps the iodide disk perfect, but also solidifies fluid objects when required.

"Such is the case with the subject you may behold to-night, namely, a part of a section through the new Atlantic conductor for the transmission of speech, of which you, no doubt, have read in the newspapers.

"It is magnified enormously, so that the molecular structure of the various parts of the cable are easily discernible."

I had, while he spoke, stepped forward and looked into the eyepiece.

At first I could notice but a vast expanse of space like the heavens, and dimly lighted and divided into two principal sections of

PROF. ELIHU THOMSON, LYNN, MASS.

different very light tints. Gradually, my eye becoming more accustomed, objects in the foreground took more decided forms.

The right side of the expanse was of a light pinkish tint, while the larger left portion appeared transparent and almost devoid of color. As I looked sharper a curious network appeared as if spread in the foreground. In the reddish section this network looked like an immense sponge of extremely fine needle crystals, the pores of the sponge being abnormally large in proportion to the thin structure-forming needles. But there was great regularity of shapes, so that it reminded partly of a honeycomb, without, however, giving a conception of body or thickness.

The network in front of the larger portion of the expanse, however, consisted really of detached but nearly touching elongated forms of a compound character. I distinguished in each form three round bubbles, a center large one and two much smaller ones adhering to the larger on opposite sides. Each bubble consisted of a number of minute balls, exactly alike in size, but differing in size for each bubble.

"The network structure to the right," explained the overseer, "forms part of the conductor and shows the slender needle-shaped molecules of copper, held together end to end by molecular affinity into regular geometrical figures.

"The compound bubbles to the left are the compound molecules of purified oil, the larger bubbles being carbon molecules, the next size oxygen and the smallest hydrogen molecules, the two latter being separated by the first.

"In reality the new submarine conductor consists of a tube made of nickel steel, filled with oil and three feet in diameter, through the center of which, held in place by wooden braces, passes a twisted copper wire conductor one inch in diameter. The steel tube is suspended in the ocean on permanent floats anchored a mile apart, and it stretches from Halifax in Nova Scotia, to Valentia in Ireland, at a depth of 75 feet below the surface of the ocean.

"The theory on which this line was built holds that electricity is a flow of ether through and along a conductor, and that a good conductor has the faculty of attracting and condensing ether within and around itself.

"The flow of ether produced by a generator of any kind will be held attracted along a conductor, but will drag with itself the surrounding non-condensed ether all along the line. It is, therefore, important that in a first-class line, such as is needed for the transmission of the rapidly vibrating impulses of speech currents, no substance which is termed a good conductor should be in the immediate neighborhood of the current carrier, because such conducting body would have condensed on its surface a thick layer of ether which would offer a frictional resistance to the flow of ether in and along the current carrier, resulting in a drag or retardation of the current.

"Nothing is more detrimental to the transmission of speech than retardation which obliterates, first, the delicate curves of the consonants, next, the vowel waves, and lastly flattens out into a straight current even the more prominent mere musical undulations of sound.

"To overcome as much as possible this retardation, it is therefore necessary to surround the conductor with a sufficiently wide area of a medium which does not condense ether and thereby reduce the frictional resistance to the current; and of all applicable substances, purified oils have the least affinity for ether and do not condense it.

"To prove to you the existence of ether condensation," continued the overseer, "I

CHARLES F. BRUSH, CLEVELAND.

will now develop into the microscopic field a powerful electromagnetic distortion and at the same time illuminate it by polarized light from a million candle-power arc light; look!"

Instantly the vast expanse brightened up perceptibly; the network of molecules darkened, but between the needles and the compound bubbles there appeared the faint silvery outlines of the ether particles. Round, as tiny soap-bubbles, they were on the extreme left, just touching lightly and barely compressing each other. Passing toward the right they appeared slightly elongated, and in the neighborhood of and in the spaces between the copper molecules they were pressed together in a dense mass of oblong streaks of silver, giving the effect of a halo along the line of the copper conductor.

"What," inquired I, "would be the result of a rapidly interrupted current on the conductor, as viewed through the microscope?"

"Take this telephone," said the overseer, "and I will gradually raise the pitch of this rheotome and when you think the interruptions are rapid enough I will charge the field in the microscope with them with the aid of an inductorium, and you may see for yourself the effect."

I put the telephone up, he turned a switch, and the low rumble of the rheotome reverberated in my ear. Suddenly it ceased; I felt a shock and saw a light flash.

"Here we are!—Bladensburg!" the cabman shouted.

Men of Ability and Genius in the Electric Lighting Field.

In the portrait gallery presented in this issue of the REVIEW will be seen the faces of three men whose names are imperishable in the records of electrical invention. These names are Edison, Thomson and Brush. The first the most versatile of inventors, the other two possessing the inventive quality in a very large degree and at all times careful and clean cut in their work, so that when it was presented to the public for adoption or rejection it immediately found an abiding place in the industrial progress of the time.

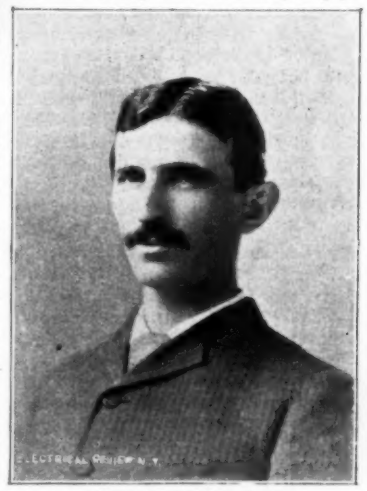
It is nothing to the discredit of these three gentlemen that, while they have worked so earnestly and triumphantly, they have been appreciated in a commercial way, and a comfortable fortune belongs to each.

Our picture gallery also contains the countenances of Nikola Tesla, the brilliant young inventor; of Mr. J. J. Wood, one of the earliest workers in arc lighting, and whose dynamo machine ranks among the very first in the field; Mr. R. T. McDonald, one of the most energetic and successful of electric light manufacturers and organizers.

There are many other names indentified with the wonderful development, both technical and commercial, that has brought the electrical industry so rapidly to the front. The list of names identified with the electric lighting and electric power industry is a long one. It should include Charles A. Coffin, of Boston, and his associates, E. J. Garfield, S. A. Barton and others; George Westinghouse, Jr., of Pittsburgh; Edward Weston, Edward H. Johnson, Frank J. Sprague, S. Insull and Stephen D. Field, of New York; W. Stanley, Jr., Pittsfield, Mass.; O. Shallenberger, of Pittsburgh; M. M. M. Slattery, of Fort Wayne; Capt. Eugene Griffin and O. T. Crosby, of Boston; Charles E. Dustin, of Hartford, Conn.; Prof. William A. Anthony, of Manchester, Conn.; Frank A. Perret, S. S. Wheeler, and scores of other bright and enthusiastic young and active men, who, one and all, add their share to advancing the interests of the electrical industry, and particularly the branch devoted to lighting and the transmission of power.

OBITUARY.

George E. Mumford, of Rochester, N. Y., died on February 2, in Florida, aged 60 years. Mr. Mumford was born in the central part of the State, was a graduate of Williams College and was a lawyer by pro-



NIKOLA TESLA, NEW YORK.

fession. He practiced law for many years in Rochester in association with George H. Mumford, who was largely interested in the Western Union Telegraph Company in its earlier history when it had its headquarters in Rochester. In the latter years of his life George E. Mumford abandoned the practice of law, confining his attention to many business enterprises with which he was connected. He was president of the Brush Electric Light Company, of Rochester, which purchased the Genesee Falls and used the water power to furnish Rochester with electric light, a plan that has proved very successful. Mr. Mumford is survived by five sons, one of whom, Geo. S., is treasurer of the "C. & C." Electric Motor Company, of this city.

The Telegraph in America.

BY GEO. C. MAYNARD.

The Editor has set a task impossible of accomplishment. Twenty-four hours and two short columns of type to record the history of a thousand years, crowded into half a century! Morse, the American, clerical by birth-right, literary by association, devoted to art by choice and education, on the fifteenth day of November, in the year of grace, 1832, stepped from the packet ship "Sully," onto his native land, a discoverer of a new world. He was an investigator, a prophet, a hero. His mission was to send out the lines of instant communication "to the ends of the earth." For two centuries and more the world had recognized the need and waited for the man. Philosophers and students had long been investigating electrical phenomena, and amusing themselves by sending signals through long wires, but no one had trained the mysterious power to the service of man, or taught it intelligible speech. By clear insight of genius, Morse saw the problem made clear, and set himself to its practical application to human needs. Five long years of patient study and toil and the invention was complete. Money was needed to show the world its usefulness, and Morse was penniless. Faith, hope and courage were needed, and these he did not lack. Believing that the government should own and control the new invention, he appealed to Congress to aid him in making the final public test of his system. This was in 1837. It has been the common tradition that the Secretary of the Treasury, Levi Woodbury, favored Morse's plan and recommended the appropriation of $30,000, which he asked for. The story is not true. On March 10, 1837, Secretary Woodbury sent inquiries to a large number of government officials and other public men, asking their opinions regarding the possible usefulness of some system of telegraphs. The documents show that he had reference to semaphore telegraphs, and a score of replies received by him related entirely to such systems. One naval officer reported that he had surveyed Long Island and prepared detailed estimates for a line of 19 signal stations, extending from New York city to Point Judith. Another zealous naval officer submitted a similar plan for a line from Cape Cod to the Island of Naushon, now owned by the telephone Forbes family. The Franklin Institute, of Philadelphia, reported an exhaustive scientific investigation of the subject, and that authoritative body also recommended semaphores. It prepared most elaborate plans for building 36 stations, to connect Washington and New York, at a cost of $100,000, with an annual running expense of $62,500. It may be well to preserve the names of the members of the "Committee of Science and Arts," who signed the report, and here they are: R. M. Patterson, Roswell Park, Chas. B. Trego and Sears C. Walker. One advocate of this system suggested the employment of deaf and dumb persons to work the telegraph. Morse explained his telegraph, asked for the $30,000, and then spent five years more, waiting, laboring, until he got it. The House Committee on Commerce finally made a favorable report in which it declared that the adoption of Morse's telegraph would "invest the citizens of this country with *an approach to the high attribute of ubiquity* in a degree that human mind, until recently, has hardly dared to contemplate." Eight members of the committee were equally divided on the question and the ninth member, an Indiana man, whose vote decided it in favor of the appropriation, was overwhelmingly defeated by his constituents in the following election for having so foolishly wasted the people's money. The bill passed the House by a vote of 90 to 82. The delegations from Rhode Island, Connecticut, New Jersey and Michigan, were the only ones which voted solidly in its favor. The failure of Morse's underground experiment, the perfect success of his pole line between Washington and Baltimore, the sending of the scriptural message by Annie Ellsworth, are familiar to every schoolboy in the land. Morse, immediately after the success of his undertaking was demonstrated, offered the invention to the government for $100,000. The offer was refused.

On the first of April, 1845, the line was opened for public business. Alfred Vail was the operator at Washington, Henry J. Rogers, at Baltimore, with Morse himself as "extra" at either place as occasion required. The tariff, fixed by the Postmaster General, was one cent for every four characters. The receipts of the line for the first seven days were three dollars and nine cents. At this juncture Amos Kendall, one of the postmasters general who did not believe in a post and telegraph service, either "limited" or unlimited, became one of the projectors of the enterprise. The first attempt was to organize a company to build a line between New York and Philadelphia, these cities being regarded as the ones most likely to subscribe necessary capital and furnish the most business. The capital stock was fixed at $30,000, half that amount to be paid in. Capitalists were shy and for some time the solicitors subsided on cheap lunches paid for out of the meagre receipts from curiosity seekers who were admitted to the office at 25 cents a head. Stock subscriptions ranged from $100 to $2,750. The sums paid in by several men who, a little later, were telegraph millionaires, were $500 each. Railroads refused rights of way, residents along turnpikes feared witchcraft, and with many difficulties lines were erected and maintained. Slender and short poles, No. 14 copper wires, glass bureau drawer knobs for insulators, were the dependencies in those days. Besides frequent accidental interruptions, there was much trouble from malicious interference, and the men in charge of the lines might well have followed the advice of Sir Francis Ronalds who, when asked what he would do in case evil disposed persons broke down his telegraphs, replied, he "would kill them if he could catch them, d——n them if he couldn't, and, in either event, repair the wires without delay." The rates first established for ten word messages were, from New York to New Brunswick, 10 cents; to Philadelphia, 25 cents; to Washington, 50 cents. The New York office for the receipt and delivery of messages was in New York, the operating room was in Jersey City. After a year or two of ferriage a line was built up the Hudson to West Point, where it was strung across the river on high masts and down on the opposite side. An unarmored cable was laid between New York and Jersey City in 1848 but failed to work, and not until 1856 did the attempts to cable the Hudson prove successful.

ERASTUS WIMAN, OF NEW YORK, AN EARNEST ADVOCATE OF ELECTRICAL DEVELOPMENT.

The practical utility of the electro-magnetic telegraph, and its usefulness in every department of commercial and social affairs, quickly became apparent, though, for a long while, the receipt of a telegram was regarded as a death notice, and patrons *would* believe the enveloped despatches came over the wires. Many intelligent persons are still of that opinion.

New companies were rapidly organized and lines constructed in every State east of the Rocky Mountains, and in 1849 there were 64 companies operating under the Morse patents. Their lines connected New York, Boston, Portland, Calais, St. Johns, Montreal, Quebec, Niagara Falls, Port Sarnia, Detroit, Chicago, Milwaukee, Keokuk, St. Louis, Louisville, Cincinnati, Nashville, New Orleans, Savannah, Wheeling, Pittsburgh, Harrisburg and intermediate places. The offices numbered 293. The largest offices employed from three to six persons, the others one. The latter served as manager, operator, messenger, batteryman and lineman—a most unique pounder of brass and expounder of electrical science. His length of service and official rank were indicated by his crimson spotted trousers, liberally decorated in his daily avocation of scouring Grove battery zincs with a toothbrush. An operator who received a salary of $600 a year was a Vanderbilt. Many of them had the privilege of using all the receipts of their offices to buy provisions for themselves and acids for the batteries. The batteries were maintained, but the operators sometimes went hungry. The president of the Maryland Company was charged, by resolution of the board of directors, with the duty of "making the business agreeable to those engaged in it." Such instructions are unnecessary nowadays.

Manner of construction, methods of operation, expedients in emergencies were crude, awkward, sometimes amusing, often failures, but always progressive. Plain iron wire, solid and stranded, was largely used. Insulators of every conceivable material and pattern were tried. In this period of the business, it was recorded that "nearly every telegrapher in the United States has invented an insulator and many lines have been ruined by the sad experiments." Less than a year after the Washington and New Orleans line was built, the superintendent was ordered to "reinsulate the line from Washington to Petersburg forthwith." Twenty-five years later a famous electrical engineer and telegraph manager, who will recognize himself if he reads this, invented and patented an insulator, the first lot of which, amounting to 50,000, was sold to the government and used on its military lines. The insulation washed out of them in the first day's rain and that line had to be "reinsulated forthwith." Under the rules of one of the largest companies the superintendent of repairs lost pay for every day the line was out of working order, and half his pay "when the line works but one way." Had this rule been universal most of the linemen would have been in debt to their employers. Notwithstanding all the obstacles and drawbacks, business increased and messages were transmitted with despatch. The operators lost no opportunity to get them through by wire when it worked, by freight when it was down. They unanimously disregarded the order to receive only by paper and preserve the original record in Morse characters, and took to reading by sound. In this many of them soon became expert, and there were as rapid senders and receivers 30 years ago as there are to-day. The first sound reader is unknown. Professor Gale says it was Alfred Vail; Shaffner says it was Edward F. Brooks, of New York; the monument in the cemetery at Frankfort, Ky., bears the name of Jimmy Leonard as the one entitled to the honor. The truth is, many operators commenced reading by sound about the same time, quite independently of each other.

Up to 1853 companies multiplied and continued to do business with little or no attempt at co-operation. Competition between rival companies operating under the Morse, House and Bain patents was, at times, bitter, and expensive legal battles were fought. Messages passed over the lines of several companies before reaching their destination and it was often difficult to trace them or to get replies. Supplies were purchased at retail by local offices and at extravagant prices. Then came the "American Telegraph Confederation," organized at Washington on the 5th of March, 1853. The purpose of the organization was not consolidation of companies but to aid in securing harmony of interests, uniformity in methods of transacting business, and co-operation in procuring supplies at fair rates. The discussions were intelligent, practical and sensible. A circular letter issued by the secretary regarding the furnishing of supplies, is very interesting. It dealt largely in questions relating to the quality and cost of nitric and sulphuric acids, zinc, platina, etc., and gave positive recommendations to the operators not to mix the two kinds of acid before charging the Grove batteries. Superior clocks, bearing the stamp "American Telegraph" were offered to all offices at ten dollars each. The manufacturer, a Connecticut man, of course, said, "he would warrant them to keep the time correct as to the day of the month, hour, minute and second, and that he would start them with genuine Connecticut time and tumble them over railroads, wagons, steamboats, drays, and by hand, and land them in Halifax or St. Louis, still running with the correct time of New England. He would mark the moment of shipment, and its time of delivery would indicate how long the clock had been wandering to its new home." If one of those time pieces is still in existence it should be preserved. The result of the confederation was a saving in the cost of operating lines, an improvement in the service and a decided step towards consolidation.

At the close of the year 1853 there were 41,000 miles of wire in use and the capital stock of the companies was something over $6,500,000. By this time the horizon began to broaden and telegraph promoters became more ambitious and confident. The following year a line to the Pacific coast was proposed and a company offered to put it in operation, provided the government would assist.

Congress accepted the proposal and a bill was passed authorizing the company to go ahead, and agreeing to give it two million acres of land on completion of the line, with the reservation that the government should have the free use of the line to the extent of 8,000 words monthly. The tariff was fixed at $10 for 10 words. The plan of the company, as approved by Congress, was to run a line of two conductors "thoroughly insulated and placed under the surface of the earth, rock or water, with testing tubes every five miles." It was estimated to cost $1,150 per mile, a total of $2,760,000. The result it is not necessary to note. In 1860 a few experienced telegraph men set out to cross the continent with an overhead line, and it was speedily built. Its value to the government during the war cannot be overestimated. Ocean telegraphy was much discussed and the possibility of spanning the Atlantic was hinted. To most men this scheme was too visionary for consideration. The able diplomat and telegraphist who now serves the government in an important consulate in Scotland, and who sends and receives cablegrams as a daily pastime, then announced that "he would not give the subject of ocean telegraphy any serious faith," and printed strong arguments to prove the impossibility of its success. America, determined to be ready to meet the old country should she find solution of the problem and send a line to the shores of the new world, pushed through wilderness and across waters to the farthest point of the Western Hemisphere, and waited. England still hesitated and America took the lead and through the untiring efforts of Cyrus W. Field carried the undertaking to perfect success. The Atlantic is threaded with cables, and at this moment a vessel carrying the Stars and Stripes is completing the survey of a route through the Pacific. On land and on sea the United States holds its rightful place. The success of the first Atlantic cable made the failure of the bold attempt to penetrate the icy North and cross Behring Straits less disappointing, and the loss of $3,000,000 not so serious.

The second decade in the history of the telegraph saw many changes. Small companies here and there joined their fortunes, competition slackened, lines and service greatly improved, profits became possible. The Bain claims were out of the way, the House printing system was found useless for general purposes. The Morse system carried the day. The war made most extraordinary demands on the telegraph, and every one was promptly met. The account of that period is a history of itself. The telegraph in the South was the first thing to be reconstructed, and the men who had the work to do were equal to the occasion. Consolidation went on gradually and irregularly for a while, until Hiram Sibley hung out his banner bearing the motto *"In Unitate Vis."* That motto, faithfully followed from that day to this, has given the company then organized the rightful control of the telegraph business, not only of a few Western States, but of the Western Continent, and has provided for the people of this country a service superior to any other in existence.

Statistics showing the growth of the business would present a great array of figures which the REVIEW could not print, and which nobody would read, if it did. At the commencement of 1892, 45,000 men and women were employed in the service. The number of offices was 25,000, and the length of wire 900,000 miles. The capital invested was on the farther side of $100,000,000.

Improvements in apparatus and methods have been as marked as the increase of the business. Durable lines, infinitely better insulation, automatic repeaters, duplex and quadruplex instruments, improved batteries and dynamo currents, typewriter receivers, well-appointed offices, most efficient operators, admirable discipline; these go to make the American telegraph the most magnificent establishment in the land. The facilities it affords are a marvel and a revelation.

Of the intelligence, the skill, the ability to command and the ability to obey, the spirit of the men who make all this possible, nothing can be written here. To mention one name suggests hundreds. The deeds and the memories of the living and the dead are intertwined. Faith and devotion they have given to their work, gratitude and praise belong to them.

Telephone and Street Railway Litigation.

The opinion of Judge Rice in the case of the Central Telephone Company *vs.* the West Side Electric Railway, of Wilkes Barre, Pa., was filed recently.

The injunction is continued until further orders with permission to the defendant company to move to dissolve upon making various proofs suggested in the opinion and also upon their giving security in sums directed by the court for the payment of all damages to the plaintiff which it may be adjudged liable for.

The principal points in the opinion are that "an electrical passenger railway is bound to use reasonable care and prudence in placing its wires and poles and to adopt the usual methods to prevent contact between its trolley and feed wire and the wires of the Telephone Company, and upon their failing in the above precaution they may be restrained by an injunction from operating."

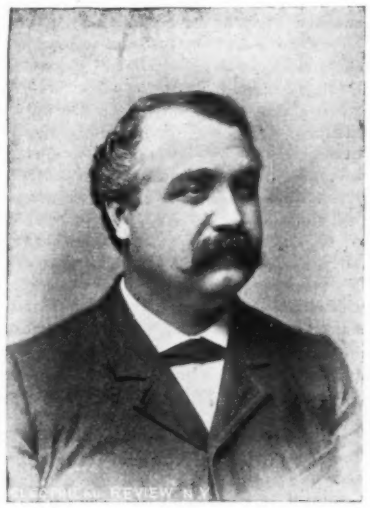
It appears that connection between the plaintiff's and defendant's wires may be prevented by a guard wire, but the evidence shows that no guard wires have been put up; therefore, the injunction will be continued for the present.

It is the duty of a telephone company using a public highway for its poles and wires to construct and maintain its line so as not to incommode the public use of the highway. Hence, as alleged by the defendant, the plaintiff can avoid the dangers from actual contact of its wires with those of the electric railway by stretching them on higher poles. The telephone company is not entitled to an indemnification for the cost of making the necessary changes.

The Utilization of Exhaust Steam for Heating Purposes.

BY C. M. MORSE.

In connection with central station electric lighting, of course the first consideration is economy in production of power. Where water can be readily obtained, condensing engines effect great positive saving in the cost of operating over the non-condensing engines, which many companies are forced to use because of the location of their stations at a distance from any available supply of water for condensing. It is to stations operating with non-condensing engines and located in thickly settled sections of cities that the question of disposing of the exhaust



R. T. McDONALD, THE ENERGETIC EXECUTIVE HEAD OF THE FT. WAYNE ELECTRIC COMPANY.

steam to advantage appeals with considerable force, because it is easy for those interested to appreciate the profits that may accrue if this otherwise waste product can be made to pay revenue.

The Thomson-Houston Electric Light and Power Company, of Buffalo, are in a position to congratulate themselves upon a recent addition to their plant, which places them in a better position relatively to their competitors, who are more fortunate in having stations located near adequate water supplies, for condensing their exhaust steam and thus reducing materially the cost of producing power. The company referred to has succeeded in arranging to sell the exhaust steam from their engines to neighboring buildings for heating purposes, and they are now obtaining sufficient income from the sale of such steam from their engines that operate in the day time, to enable them to drive their dynamos at a less expense than would be necessary to operate condensing engines, if the condensing water should cost nothing. The exhaust steam is carried, at atmospheric pressure, through properly arranged pipes laid underground to the several buildings where it is made to do duty in radiators and heating coils.

The Barnard vacuum system of circulating exhaust steam at atmospheric pressure, which is used in this plant, is peculiarly adapted for the work performed, and the complete central station heating plant now in use embraces details of arrangement and construction which cannot but be of great interest to engineers and to every one interested in the construction and operation of electric plants.

This plant is located, like most central station light and power plants, in a district containing many users of steam for heating, and the use of their boilers for making steam to sell in the neighborhood in the daytime, when the greater part of their plant was otherwise idle, early appealed to the management as suggestive of profit, for the reason that it is well established by experiment and practice that the cost of producing steam at a central station, for use over large areas, is much less than the cost of producing the same steam in independent heating boilers, in the several buildings to be heated.

Each 10,000 cubic feet of space in buildings, as ordinarily constructed, requires an average of about 30 pounds of steam per hour for heating. In ordinarily well set horizontal tubular boilers four pounds of coal will produce 30 pounds of steam per hour. Special boilers used exclusively for heating require at least eight pounds of coal per hour for the same amount of steam produced, and as such boilers are usually not well attended and consume considerable coal for keeping the fires alive, when not supplying steam for heating, 10 pounds of coal may be assumed for such boilers to produce the same results as obtained from four pounds of coal used in a large boiler plant producing at the same time steam for power purposes, or in ordinary factory boilers.

The special heating from independent boilers costs, in other words, 2½ times as much as heating from a central station.

The economy of heating with live steam from this particular boiler plant, the Thomson-Houston Electric Light Company's station, having been proven by actual practice, it was discovered that steam heat is required for night as well as day, and that while the boiler plant is entirely used for furnishing steam to the engines at night, the exhaust was being thrown away and this condition has led to the adoption of the Barnard system for circulating the exhaust steam from the engines through the heating mains and coils. Such use of the exhaust steam is accomplished without any back pressure on the engines and at practically no cost to the company.

Under this system 30 pounds of exhaust steam, the equivalent of one horse-power for one hour, delivered into a steam heating main is worth at least 97 per cent. of live steam at boiler pressure for heating purposes.

Central stations, well located, may safely contract to heat neighboring buildings to at least 80 per cent. of their total boiler capacity without impairing the engine efficiency of the station.

Referring to the particular system of circulating exhaust steam in use by the Thomson-Houston Company, in Buffalo, it seems

JAMES J. WOOD, OF FT. WAYNE, IND., INVENTOR OF THE WOOD SYSTEM OF ARC LIGHTING.

to be the outcome of several efforts on the part of different engineers to accomplish the results obtained. The Barnard system was adopted in this instance upon what appeared to be sufficient guarantees as to what it might accomplish, which warranted its trial, and the results so far shown have more than met all expectations in the matter, proving the claims for it, namely:

That with sufficient exhaust steam it costs practically nothing to heat a building.

That this system will circulate steam without initial or back pressure throughout the most extensive heating plants.

In this instance the exhaust is carried in the longest supply main, a distance of about 400 feet, to the building that is heated by that main, and the service now given from the several mains is only a small part of that to be obtained from the extensive plant contemplated.

Exhaust steam is fully as efficient as live steam for ordinary heating purposes, the total temperatures of the sensible and latent heat being practically the same for all pressure as ordinarily used.

In this system no attempt is made to return the water of condensation mechanically. In producing the circulation, the apparatus deals only with the air and the steam or vapor in the radiators or return pipes. A small condensing apparatus is employed for the purpose of maintaining a sufficient degree of vacuum, to thoroughly draught the steam to the radiators and to relieve the radiators of all possible accumulation of air. The doing away with all necessity for air valves and the ordinary condition of a steam heating plant, requiring periodical attention to the tendency of the radiators to become air bound and consequently of no use as heaters, until the air is allowed to escape from them, is a consideration which will appeal to anybody familiar with steam heating plants.

The condensing apparatus employed in this system represents the use of practically no power, as a surface condenser is employed and the water required for condensing the vapor is a part of the boiler feed water, which flows through the condenser on its way to the boiler feed pump. This system of circulating the steam is free from the expense and complications of steam traps, air valves and check valves; that is, such appliances do not form a part of the Barnard apparatus.

In the heating apparatus referred to above, about one-half of the water of condensation is returned to the boiler-room by gravity, and where that is not practicable, the water is allowed to drain to the sewer. The question of the advisability of returning by mechanical appliances, the water of condensation that is otherwise wasted, has not yet been considered in this instance, and it is hardly possible that it would pay to do so, because, although at first sight there appears to be considerable waste of water at a high temperature which might be valuable as feed water for the boilers, investigation shows that the steam used in the heating apparatus and then allowed to go to waste, is such a small part of the total exhaust from the engines, that there seems to be no appreciable diminution of the efficiency of the feed water heater attached to the main exhaust pipe of the station.

A more complete description of the above-mentioned plant, with details of construction, illustrated, might be interesting, but the facts and figures stated above are, we think, sufficient to accomplish our object, which is to call the reader's attention to the possible increase of revenue to be derived from a power plant, primarily designed to furnish power for operating dynamos. The designing and the installing of the above-described plant was done by the Buffalo Engineering Company, who have by no means confined their efforts in this field to this particular plant. They have by proper adaptation of the same system, been able to make economically efficient, numerous formerly defective steam heating plants, and to design new plants which are peculiarly representative of the practical economy and efficiency of heating buildings with exhaust steam, without back pressure and consequent expensive load on the engines. Several factories and office buildings in Buffalo are equipped with apparatus installed by them and they have apparently only started in a field which promises great returns.

The East River Electric Light Company, of New York, City has applied to the Supreme Court for permission to change its name to the Thomson-Houston Electric Company, of New York.

Public Works Commissioner Gilroy has received a peremptory order from Mayor Grant for the removal of all overhead electric light, telegraph and telephone poles and wires in sections of New York city where the companies owning them promised to have them removed by January 15.

FOOTPRINTS OF A DECADE.

Progress in Electric Lighting, Power Transmission, Etc., Etc.

A CAREFUL REVIEW OF THE VARIOUS STAGES OF ELECTRICAL DEVELOPMENT DURING THE PAST TEN YEARS.

ELECTRIC LIGHTING.

When we reflect that in the past decade have been developed most of the electrical applications which minister to our daily wants, it is difficult to understand how such gigantic strides can have been taken. Electricity will soon be the ruling force of the world. It furnishes light, power, transportation, brings remote corners of the world into business communication, and will, at no distant day, have a large application as a source of heat. The ELECTRICAL REVIEW has given a faithful chronicle, during the ten years of its existence, of every inch in this triumphant march of electrical progress. We propose to recall briefly a few of the leading incidents noted in its pages relating to electric lighting, transmission of power and other applications, and thus show how the present commanding industrial position has been attained.

In the opening of the decade, arc and incandescent lighting was entering on a successful stage of its commercial existence. On April 1, 1882, 55,300 feet of street mains had been laid from the great Pearl street central station of the Edison Company in New York—the first in this country—946 houses having been wired in February and 14,311 lamps supplied. The impetus given by this system influenced the whole civilized world, and incandescent lighting at once gained an assured footing as a domestic illuminant. In April, 1882, two Edison 12 Z dynamos were run in multiple arc at the Crystal Palace, and also two steam dynamos were operated in multiple arc on the Holborn viaduct, London. The successful effort to drive two mammoth generators in parallel was an event of great industrial importance, as demonstrating that the capacity of a central station might be indefinitely extended and its output be regulated to suit every demand. From that time to the present the field of electric lighting increased with tremendous rapidity, so that to-day there are over 5,000,000 incandescent lamps in nightly use in the United States, and the annual production is probably 7,500,000.

The first Edison isolated plant was installed in the printing establishment of Hinds, Ketchem & Company, Brooklyn, in 1880. In 1891, there were in use over 6,000 isolated plants.

On October 1, 1883, the three wire direct current system was first used in Brockton, Mass., demonstrating that two generators might be coupled in series and the combined electromotive force of the two used to overcome the line resistance, while the establishment of a third wire between the two machines made it possible to use, in any one building supplied, the tension of only one generator. This method resulted in lowering the electrical losses of distribution without materially increasing the amount of copper needed in the mains. Hundreds of active and brilliant minds were devoted to the development of the art and thousands of patents have been issued for detailed improvements.

The lamp itself has been an object of great study and the first crude lamp, with a spiral platinum wire for a filament, has given place to the beautiful hair-like filament variously prepared by the great inventors, who have worked incessantly for the production of a perfect lamp. Filaments of carbonized paper gave way to slender fibres of bamboo or other fibres of kindred nature, or to a strand of carbonized silk, or to a slender strip of cellulose.

The crude methods of exhaustion at first used to produce the vacuous environment in which the glowing filament pursues a career for 600 hours of brilliancy, have made room for the refined methods of the Sprengel and the Geissler pumps by which all but one-millionth of the air is exhausted. Scientists, before the day of electric lights, never knew such vacua.

Numerous organizations have sprung into existence, inspired with prospects of financial reward by the great success of the electric light, and have, by their vigorous rivalry, pursued with the liveliest interest every line of promised improvement in excellence or cheapness of service, a competition which has resulted in a score of great factories humming with activity. Our own country is the center of this great industry, and supplies not only the lamps used for domestic consumption, but a large part of those used in Central and South America, Cuba, Australia, Japan and Europe. In spite, however, of the pains and ingenuity which have been expended on the lamp, it is still an expensive article, an incident resulting principally from the fragile character of its most essential part—the filament. The cost of the materials which enter its construction do not represent one-fifth of the total cost. We may confidently expect, however, that the manufacture will be greatly cheapened. The labor is principally hand-work of great skill as the manufacture is now conducted, and each lamp must be handled by about 50 persons before it is a completed product. Already a method of repairing the filament has been devised and is in successful operation at Boston—the Pauthonier process.

In arc lighting, also, great progress has been made. An impetus was first given by the Brush arc machine and lamp in the latter part of the seventies, and numerous other distinguished inventors, among whom stand out prominently Elihu Thomson and Edward Weston, contributed to the scientific achievements which enabled the energetic organizations who commercially pressed their inventions to widely diffuse arc lighting.

A vast amount of inventive ingenuity has been expended upon the details of electric lighting, as the thousands of patents issued by the Patent Office for cut-outs, arc lamp regulators, sockets and keys, systems of distribution, dynamo regulation, etc., testify. The generator has been brought to a degree of perfection unrivaled in any other type of energy converter, 96 per cent. of the power delivered being yielded as electric energy. The continuous current dynamo of to-day is a work of art. The various steps of its construction are operations of special skill. The energy expended upon the improvement of the electric light has lapped over many other industries. New types of engines, for instance, have been invented and brought to a degree of perfection never before realized. Radical improvements have been made in generators during the past decade. Compound and over compound wound machines have come into use during this period, and are now almost exclusively used in this country. The lighting of railway trains has also become frequent. One of the early efforts in this line was upon a train on the London, Brighton and South Coast Railway, in England, February 15, 1882, when 29 lamps were used on a Pullman train, the current being furnished by a battery of Faure accumulators. In April, 1884, on the London-Chatham Railway, passenger cars were electrically lighted, the current being generated by power supplied by a Willans engine, the engine and dynamo equipment being mounted on the baggage car.

While domestic and municipal lighting have experienced the broadest development, many subsidiary uses for the electric light have been found and utilized during this decade. The lighting of mines was witnessed as early as 1881. As a locomotive headlight the electric light was in use as early as 1881, in France, where the locomotive engine operated the dynamo, and in Austria, where an auxiliary brotherhood engine was used.

The electric light has been applied to a large number of special uses; in dentistry and surgery the incandescent lamp is used to explore hidden recesses of the human body, and on ships the arc lamp as a searchlight. In submarine work electric lighting has proven of great value. Street lighting with arc lamps has had an enormous development. Almost every progressive town in the United States has electrically lighted streets. Inventors are not, however, content with the present stage of development in electric lighting. The dream of those who keep in the van of progress is to produce a light of greater efficiency. Under the present method only a small proportion of the energy is given off as light. Scientific investigation of the spectrum shows that most of the energy is lost in heat and non-luminous waves, and busy minds are searching for some mode of conversion of mechanical energy which will copy the principles at work in the common fire-fly, where almost all the energy is given off as luminous waves, and, consequently, an almost perfect conversion exists. We dare not say, in the face of the marvelous achievements already made, that such a dream will not be realized. An interesting series of experiments, made within the year by Mr. Tesla, shows that a lamp filament may be made to glow without any metallic connections with a supply circuit. Alternating currents of great frequency and high tension may create a field between the walls of a room, within which an interposed condenser connected with a lamp filament will produce incandescence. As the art matures, new possibilities loom into view. It is safe to predict that another decade will witness progress no less striking than the one just passed.

LIGHTING BY ALTERNATING CURRENTS.

The latter half of the decade is specially notable for the tremendous development in the application of alternating currents. The initial impetus was given by Gaulard & Gibbs, who patented a transformer system, in which induction transformers were used locally to supply low tension currents for lighting, a high tension current being transmitted over a line wire and carried through the primary coil of the transformer. The Gaulard & Gibbs system was tested as early as April 1, 1884, by Dr. John Hopkinson, at Edgeworth Road, and showed an efficiency of 89 per cent. The primary circuit was fed by a Siemens alternate current machine, and was 15 miles in length and of No. 8 copper wire. The use of alternating currents to supply a current of high electromotive force, and capable of overcoming line resistance in combination with transformers to reduce the tension and increase the quantity for local consumption, although not broadly new at the date of Gaulard & Gibbs' invention, gave such excellent results in electric lighting, by reason of the ability to use commutatorless generators and transmit currents of high tension, that it soon met with a warm commercial reception. The Westinghouse Electric Company first started the ball rolling in this country, and other companies soon followed.

Although it has been only five years since the first alternating current plant was erected, this system of lighting has spread so rapidly that it is now in use all over the country. It is well adapted for long distance transmission, for the reason that high tension currents may be generated without injury to the dynamos, ring contacts being used instead of the commutators necessary in direct current generation. A very important incident follows the use of high tension currents, namely, line wires of small cross section may be used, resulting in a great saving of copper.

ELECTRIC METERS.

Among the many collateral branches of electric lighting, the meter stands in the first rank in point of interest. This has received its full share of attention from the indefatigable inventor. The public wanted to pay only for the current it used, as it did for gas and other commodities. Numerous types of meters have been brought out, both for direct and alternating currents, and about 200 United States pateuts have been issued. The leading types, however, may be regarded as the Edison, Shallenberger, Aron, Thomson and Walker meters.

The Edison electrolytic meter for direct currents is provided with an electrolytic cell placed in a shunt circuit, the resistance being so proportioned that only a definite fraction of the current passes through the cell. A conducting salt is used, from which the metal is deposited by the current from one electrode to another, the rate of deposit depending upon the amount of current passing through the meter. The consumption of electrical energy is determined by ascertaining the increase of weight of the electrode which receives the deposit.

The Shallenberger meter is designed only for the alternating current. In this a field of force is induced by the alternating current and a field polar line developed; a second polar line is developed in the armature by an auxiliary circuit. The polar line of the armature is displaced with reference to that of the field and rotation results. The speed of rotation is kept down by a set of fans.

The Aron meter has as its underlying principle the ascertaining of current consumed by noting the difference in the rate of movement of two clocks, one of which is affected by the current being used. The apparatus consists of two pendulums regulated so as to oscillate synchronously. One is of the usual construction and the other carries a steel magnet at its extremity. Both are kept in movement by spring power and act jointly upon a dial train, which counts the differences of their oscillations. Both pendulums normally oscillate synchronously, but when current passes one is caused to swing faster as current increases, causing registration by means of the dial train.

The Thomson watt-meter is also of the motor type and comprises a set of coils wound on a hollow frame constituting the armature, through which passes a vertical shaft. The coils are connected to a commutator on the shaft, to which current is led by two brushes. The coils of the armature are wound with fine wire and are in series, with a resistance varying according to the voltage. The armature is in shunt across the mains. Surrounding the armature is a set of fixed coils through which the current to be measured passes. The armature shaft is connected with the register by which the current is measured. A retarding device, comprising a copper disk rotating in a magnetic field, is used.

The Walker meter comprises an ammeter, the fluctuations of which are recorded by photography. The point of light is projected by the ammeter needle upon the sensitive paper upon which a curved line representing the fluctuations of consumption is traced.

ELECTRIC POWER.

One of the most promising branches of electricity is its application for power purposes, and especially for the transmission of power. The discovery that a Gramme machine is reversible, that is to say, when two such machines are coupled together, one operating as a generator the other will operate as a motor, was the first important step taken in this line. Since then numerous efforts have been made to utilize electricity for the transmission of power over a long range. In 1886, Deprez transmitted 52 horse-power a distance of about 25 miles, with an efficiency of conversion of 45 per cent., using the maximum voltage of 6,290. Early efforts in this direction were, of course, confined to direct current machines, and a necessary limitation in the distance of transmission was introduced, by reason of the inability of the commutators to withstand very high voltages. Aside from this fact, direct currents would lend themselves with great advantage to the transmission of power by reason of the high efficiency between the motor and generator. Generators may be easily made to utilize 96 per cent. of the energy expended upon

their armature shafts, and motors may be made of corresponding efficiency, thus giving a total efficiency of 92 per cent., aside from losses due to the wire transmission. Until, however, some method shall have been devised by which the destructive effect of high tensions upon commutators can be avoided, direct currents will be confined to the transmission of power within a comparatively short radius. For street railway and similar applications it is eminently well fitted, and, as will presently be seen, has met with the wide application which its efficiency and adaptability deserves.

Up to 1884 the transmission of power had scarcely passed the experimental stage in this country, although applications had been made abroad in 1882. Professor Ayrton rode an electric tricycle in London, operated by four accumulators, weighing one and a half hundredweight, and the launch "Electricity" was operated at a mean speed of nine miles per hour, carrying 12 persons, on the Thames, and was said to be thoroughly successful.

The direct current has been largely used for subterranean operations, especially for driving rock drills, and has given great satisfaction. It has also been used to train heavy guns and to operate Gatling guns, dispensing with the necessity of manual manipulation of the gun when in action. But for long distance transmission of power, such as the utilization of a distant waterfall, the alternating current seems adapted *par excellence*.

In countries which are thickly settled, where water powers are for the most part taken up and have a commercially recognized value, the advantage of electric transmission is not so great as in a country like the United States, and especially the western portion, where there are thousands of waterfalls, the power of which is going to waste, and which may be secured at small expense and harnessed into service as an industrial factor. In such cases, the points at which it is desired to use the power may be far distant from the waterfall, and it is precisely for such a state of circumstances that the alternating current is peculiarly well adapted. These facts have been well recognized for several years, but the difficulty which has stood in the way of liberal development of this branch of electrical enterprise has been the lack of an efficient alternating current motor. Several systems have been installed in which synchronous alternating motors have been used, high-tension current being developed at the waterfall and transmitted to the motor at a point where the work is to be performed. The difficulty, however, with this type of motor is its refusal to start from a state of rest unless it is gradually brought up to speed in unison with the generator, and also the fact that when running in synchronism and overloaded it is liable to fall out of step and come to a standstill. The great advantage, however, with a synchronous motor is its high efficiency. As much as 75 per cent. of the energy delivered at its brushes may be converted into power and delivered through its shaft. It has been claimed by its advocates that, if built of sufficient power to meet all demands that may be made upon it, it will not fall out of step under change of load, and that it may readily be started by being gradually brought to speed at the beginning of operations for the day. This claim would seem, theoretically, to have some merit, but it has not gone into extensive use. In some instances a self-starting auxiliary alternating current motor, such as the Tesla type, has been adopted, wherein a rotating magnetic field is developed by two currents having a quarter phase difference, and such rotating field is used to drag around an armature provided with a closed coil. Such a motor is used to start a synchronous motor and is then cut out. The need has been strongly felt, however, of a self-starting alternating current motor which would start under load and yield an efficiency comparable to the direct current motor.

Within the past year a line has been erected in Germany, extending from Lauffen, at the Neckar Falls, to Frankfort, a distance of 108 miles, by which 300 horse-power was transmitted from the Falls to the electrical exposition buildings at Frankfort. In this system currents of enormous tension were used, about 20,000 volts—a step-up transformer by which the tension was raised being used at the generating station, and a step-down transformer by which the tension was lowered being used at the receiving station. A transformer of a peculiar type was used by which a multiplicity of alternating currents having a difference of phase were developed from three currents a third of a period apart transmitted from the power station to the delivery station over three line wires. The motor was provided like a Tesla motor, with a rotary field in which rotation of the field poles was created by means of the phasially different alternating currents, but it was claimed that a much higher efficiency was realized by reason of the small amount of self-induction in the field, resulting from the multiplicity of phases used. It is claimed for this system that an efficiency of 87 per cent. is realized. The details of the system and such data of the tests as are available have been widely published in the scientific journals and eagerly read by all who are interested in transmission of power. Doubtless, the sucess of those experiments will be followed by commercial attempts to profit by their results in this country.

It is gratifying to Americans that two of the pioneers in this art are citizens of this country, one by birth and the other by adoption, namely, Mr. Charles S. Bradley, and Mr. Nikola Tesla. Mr. Bradley was granted a patent in 1889, covering the three-phase system of generation and transmission, and Mr. Tesla has taken out a number of patents for the rotary current motor.

The possibilities offered by electrical transmission of water-power for such geographical sections as are blessed with waterfalls are tremendous, and should result in making of such districts great industrial centers. Efforts are already being made to utilize the tremendous power wasted at Niagara Falls by electrical transmission. A tunnel through the rock from a point above the Falls, to a point below them, is well under way, and it is estimated when completed to develop 125,000 horse-power, which is destined to be carried to Buffalo and other points. If the power delivered can be sold at a profit more cheaply than coal, the advantages of a favorably situated point can be readily appreciated.

The possibilities of long distance transmission are great, also, in other fields than that of a terminal distribution circuit. It seems but a slight step to make interurban electric railroads operating at high speeds a crystalized fact, and such, no doubt, will be a reality of the near future.

ELECTRIC RAILWAYS.

There is one phase of electric transmission of power which is distinctly connected, both in origin and development, with the last decade and that is electric locomotion. It has been many years since it was first proposed to operate cars by means of a current furnished by a stationary source of supply, although the conception of supplying a system of conductors by means of a dynamo and operating one or more motor-driven cars is as recent as 1877, and is due to an American, Mr. Stephen D. Field. The first commercial operation in this country is only six years old and the bulk of the enormous development in this art has taken place in the past three years. Among the early practical efforts was the exhibition of Field's electric locomotive at Chicago in 1883. In the Summer of 1882, Dr. Joseph R. Finney operated an electric street car in Allegheny, the current being supplied by an overhead copper wire and conducted by means of a trolley fitted with grooved wheels to a motor on the car. Earlier efforts were made abroad, the firm of Siemens & Halske having had a road in operation at the International Exposition of 1881. In 1882 there were 100 miles of electric railway in operation in Europe, one line at Lichterfelde, one from Spandauer Bock to Charlottenburg, near Berlin, another from Port Rush to Bush Mills, in Ireland, and one in Holland, from Zandvoort to Kostverloren.

The first commercial electric railroad in the United States was in service at Cleveland, O., about six years ago. The enormous development of this industry may be appreciated from the fact that there are now in operation over 250 electric railways in the United States, embracing 2,024 miles of track and utilizing 3,830 motor cars, operated by 6,400 motors with an estimated capacity of 174,435 horse-power.

Out of 956 street car plants existing in the United States and Canada, 589 are operated by horses, 49 by cables, 246 by electricity and 73 by steam. When it is remembered that all of this development is practically a growth of three years, some idea of the important figure electricity is destined to cut in the problem of transportation in the future may be had. The present electric railroad equipment in this country represents a value of about $49,300,000 out of a total of $164,400,000 for all street railways, of which $58,900,000 may be apportioned to horse systems, $49,000,000 to cable and $7,400,000 to steam.

In amount of track mileage, electric railroads stand next to horse railroads, the former covering 5,703 miles and the latter 2,024, while there are 527 miles of cable road and 554 of steam. The greater portion of this distinguished success is due to the energy of the promoters of the electric systems, but the present commanding position of electricity as a mode of urban and suburban transportation could never have been obtained but for the low cost of electrically operated plants. The average cost per car mile of horse railroads is about 5.7 cents; of a cable, 2.5; of an electric, 2.2, and of steam, 5 cents. The prime cost of an electric plant stands on about an equal footing with that of the horse plant. The cheapness of installation and the cheapness of operation are two arguments too strong to be resisted by street car men, and those who are operating their systems by horses are rapidly being converted to a belief in the superiority of electricity, and the number of roads operated by the latter agency is constantly increasing.

Another striking advantage appertaining to electrically operated roads is the fact that the speed is perfectly regulable, and may be varied within wide limits, high speeds or low speeds being taken at will. An average regulation speed may be said to be 12 miles per hour; the average mileage per car per day 115.

When it was first proposed to introduce electric street railways, the objection was seriously made that the grades necessary to be mounted would be an insuperable obstacle to the adoption of the electric motor. This superstition was quickly eradicated when those who thought that it was doubtful whether a five per cent. grade could be mounted were shown that 14 per cent. grades can be safely and readily taken. On the Lynn railroad, 16 foot cars are propelled over 13.2 per cent. grades.

Electric railways have rapidly spread through all parts of the United States and have shown themselves competent to handle traffic in the busiest city as well as the smallest town. At Southington, Conn., which is the smallest town in the United States having an electric street railway, there is a population of only 5,400. The cars are in service over two miles of track. The largest electric railway is at Boston, the entire system covering 284 miles of track, 60 of which are electrically equipped and upon which 312 motor cars are in operation.

Like all other departures, electric railways have met with bitter opposition from that portion of the public which is interested in competitive systems, and another which impedes progress by its ultra-conservatism.

The overhead system of supply is the one which has commended itself most strongly to street car operators, by reason of its cheapness of equipment and reliability. Doubtless, it would have a much larger application than exists to-day, especially in large cities, but for the hue and cry which has been raised against the overhead conductor as an architectural monstrosity and the false alarm as to the danger of the current. Both of these objections are, however, rapidly giving way. The voltage ordinarily employed is less than 500, and it has been repeatedly shown that no danger to human life results from such an electromotive force. Aesthetic objection is gradually being waived as the conviction is more forcibly pressed upon the public that rapid transit is an absolute necessity in large cities, and that for realizing such transit electricity, among all the modes of propulsion now in existence, is the most suitable.

Other methods of supplying the current besides overhead wires have been proposed and partially exploited, but have thus far been unable to make much of a showing. The underground conduit offers theoretically a neat solution of the problem of electric locomotion, and would remove entirely the objections which are made to the overhead system, but, although a number of trials have been made, such systems have not yet demonstrated their ability to act reliably in all conditions of weather, and the further objection arises that the cost of a well constructed conduit is very great. The system has been tried on an extensive scale in Denver, Cleveland and Boston, and to a lesser extent in several other places, but in every case the continual interruption to traffic has exhausted the patience of the traveling public, and compelled them to abandon the systems. The storage battery system is the ideal solution of the difficulty, provided a proper storage battery could be found. Invention has thus far been confined to storage batteries provided with active electrodes of lead, which make the cells very heavy, adding enormously to the aggregate weight of the car, and requiring, of course, an increase of energy to propel it. The beauty of such a system lies in the fact that it is entirely self-contained, and is not restricted to the route of fixed conductors. The first storage car was operated in Paris, in 1882, and a storage battery system has been put in practical use in Brussels, Belgium. It has also been used at several places in this country, notably on the Madison avenue line in New York city, and on the G street line in Washington. At the latter place it still continues in service. Great attention has been paid to the details of the system, so that but little time, not more than two minutes, is lost in replacing exhausted batteries with fresh ones. The great weight of the batteries themselves and the preclusion of reserve power on account of the attendant increase of weight, confines the operations of storage batteries to points where the grades are light, and would probably prevent their economical operation in places where the grades are as heavy as 10 per cent. The weight bugbear may be realized when it is noted that a 16 foot car with two motors such as are commonly used will weigh 8,000 pounds, of which 4,000 is electrical apparatus. A storage battery of the same size and capacity weighs 14,000 pounds, of which 8,000 is battery. A full load of 30 passengers would add only about 4,000 pounds. These drawbacks, however, have not prevented, as already seen, efforts to operate with storage batteries. Perhaps in the near future the battery will be so improved as to lightness and output that the only serious objection which exists against its adoption will fade away, and then we may expect as rapid development for the storage system as occurred with the overhead system.

For interurban work and high speeds the electric current seems destined to take the lead over all other sources of power. An experimental line constructed at Laurel, Md., in 1890, showed that a speed of 120 miles per hour might be maintained. The track was narrow gauge and the roadbed poorly constructed. The locomotive used weighed about 2.4 tons, the track was circular in shape, and its poor construction prevented a realization of higher speeds. The next decade will, no doubt, witness rapid

progress of electric propulsion over roads that are now exclusively operated by steam.

ELECTRIC WELDING.

An interesting art that is peculiarly the result of the last decade, is that of electric welding. Two pieces of metal may be brought together and a current of great volume passed through the joint by which the metal in the neighborhood of the surfaces of contact is quickly brought to a welding temperature and a perfect weld is made. A weld may be established between pieces of metal of almost any size. In New Haven, Conn., a the establishment of Seward & Son, a machine of this character is used to unite Norway iron to Swedish steel in such shapes as are suitable for carriage irons and fifth wheels. The burr at the joint is removed by a drop-hammer after the weld has been made. The crescent-shaped tires of bicycles are welded by the Pope Manufacturing Company; telegraph wire is welded at the works of the Trenton Iron Company, in New Jersey, and a machine has been found capable of effecting welds between pieces of wire rope. At the works of the Studebaker Brothers, in South Bend, Ind., there are nine machines, some of which are used for welding steel axles up to 1½ inch square. The welds will withstand a test of bending to 90 degrees while hot and then back again into alignment. Car tires about four inches wide and three-quarters of an inch thick, as well as smaller sizes, are welded at the same plant. Probably the heaviest work done is in the works of the Johnson Company, at Johnstown, Pa., where two 89,000 watt machines are in use for welding together rails. Pipe welding is put in practice by the Pennsylvania Railroad Company. Machines are to be used in the Charlestown Navy Yard for welding ships' chains having links up to two inches in diameter. Electric welding has also been applied to the manufacture of conical shell and scrapnel for military use. The art is capable of utilization in hundreds of instances, where ordinary forged welds would be impossible.

IN GENERAL.

In a large number of other applications electricity has made rapid progress during the past decade. In the manufacture of aluminum its influence has been felt in reducing the cost from $5 a pound in 1887 to 90 cents per pound.

The phonograph has been greatly improved, and is now widely used in business circles as a convenient stenographer.

In every new use that has been found for electricity during the decade, and in every refinement of uses that were known before, progress is noted, save in one. A few erratic gentlemen, in a moment of insanity, conceived the idea that it was humane to inflict the death penalty upon criminals by means of electricity. During the past year a number of executions have been made. The results, so far as they could be ascertained, were such as to thoroughly condemn the process of execution. Repeated application of high tension alternating currents had to be made in every instance before death resulted. The unfortunate criminals were, in some instances, actually roasted alive, their flesh, where the electrodes were applied, being scorched and blistered. It is to be hoped that so barbarous a mode of punishment will not be continued. Already part of the law under which it is inflicted has been repealed. The public will now receive a full account of the horrible details, and public opinion will, doubtless, require a complete obliteration of the obnoxious law from the statute book of the Empire State.

There is a sharp fight going on in Toronto, Can., over the introduction of the trolley system on the street car lines.

Arrangements are being made to extend the long distance telephone line from Bellows Falls to Rutland, Vt., thus giving through telephone communication to Boston.

An electrical parcels delivery van will be tried in London, by the Electrical Carriage Company. It will carry about a half a ton of goods and is to be operated by current supplied from accumulators. It will run for 2½ hours at a speed of six miles an hour.

Telegraphic Shorthand.

BY JOHN P. GAVIT.

When the newspaper business came to so advanced a stage that a telegraph operator was kept in the office of a good-sized daily from morning till night, taking the news as fast as it came in, it seemed as if the maximum of speed must surely have been attained. The rapidity of writing was such that the operator was obliged to run his pen or his stylus across the paper very rapidly; he had not time to lift his pen clear after each word, but slid it on to the next, and the style growing out of this habit of forming the letters in the quickest and shortest possible way, and of running the words together became known as the "telegraph hand." It was known wherever the business of the wire required rapid "sending" and "receiving," and one operator's writing looked precisely like another's.

The "telegraph hand" is passing away, never to return, and writers' cramp is to be an unknown ailment with the operators of the future. Telegraphy is becoming too rapid for the pen, and the fastest kind of type-writing will be none too fast in the coming telegraphy.

It was all right till they began to send telegraphic messages, news and dispatches in shorthand. There were certain abbreviations in the earliest commercial telegraphy; names of stations along a line were cut down to their consonants, or even to single letters; operator's signatures were reduced to initials, and the commonest phrases and messages were translated into a code of numbers, such as: 1 for "Wait a moment;" 7 for "Are You Ready?" 13 for "Do you Understand?" 18 for "What is the Matter?" 30 for "End of Message," or "Circuit Closed;" 44 for "Answer Quick," etc. There were some words frequently occurring in messages which were cut down to as few letters as possible: "Ahr.," Another; "Ans.," Answer; "G. A.," Go Ahead; "G. N.," Good Night," etc., etc. All these were easily understood and easily written. Finally the maximum of speed in sending and in receiving was reached. But the necessity of sending still more in even shorter time became more urgent. Somebody had to devise a means of progressing still further toward the infinitely rapid and the infinitesimally short.

This necessity was especially urgent in the cases of those papers which leased wires, and to whom it became an object to send a great deal of matter in a very short time. Such papers hired the fastest operators obtainable, and made it pay them to increase their speed to its highest limit. Still it seemed as if some way of even further increasing speed must be devised. And bright wits were at work on the problem. The idea of abbreviating more generally was, of course, the most natural, and it often was thought of; the trouble with such a proposition was that already the rapid operators were sending as fast as the rapid men could write it out, and if the receiving operator should copy the abbreviations it would all have to be translated and "spelled out" before the printers could make "head or tail" of it.

The first man to solve this problem was Walter P. Phillips, now general manager of the United Press. At that time he was the Washington operator on a leased special wire from Washington to Chicago, controlled by a leading Chicago daily. Only the fastest operators could receive his messages, and nobody could receive and spell out his abbreviations. After much puzzling, he at last had one of the old-fashioned recording machines set up in the Chicago office, and two operators were kept busy translating the abbreviations as the paper ribbons slipped out of the machines. For a long time this scheme was used on that wire. It was expensive to keep two operators at work amplifying Phillip's abbreviations, but it would have cost much more to lease a second wire, and "the dear public must have the news." It was some years before any other operators tried the abbreviations to any considerable extent. The means of using this telegraph shorthand was discovered largely by accident, through the typewriter.

A few newspapers furnished machines, a few operators bought them for themselves. Then the telegraph editors whose operators still clung to the pen and the stylus began to demand typewriter "copy," and the number of typewriters increased. At this stage in the proceedings it was found that a fairly proficient typewriter operator could receive faster than the fastest man could send, and then it was that the abbreviations began in earnest. Mr. Phillips had, in the meantime, resigned his place on the Chicago wire, and had become general manager of the United Press in New York. He soon saw that with a rapid use of the typewriter, his code of abbreviations could be largely increased, yet still be practicable. Thus it was that the "Phillips' Code" of telegraphic shorthand came into general use.

It was very simple at first, but as the operators became more proficient and were able to ignore the clicking of the typewriter and pay strict attention to the telegraph sounder, the number of abbreviations was increased, until to-day the Phillips' Code is a very complete system of shorthand, adapted especially to sending news by wire, but in use also among many reporters, and it is driving the pen and the stylus out of the telegraph business.

This code is on a scientific plan, and is divisible into three divisions, of single, double and triple-letter contractions. The first consists of single letters, mostly consonants, each letter standing for a word or group of words, thus:

B stands for "be," c—"see," d—"in the," f—"of the," g—"from the," h—"has," j—"by which," k—"out of the," m—"more," n—"not," o—"of," p—"per," q—"on the," r—"are," t—"the," u—"you," v—"of which," w—"with," x—"in which," y—"year," and z—"from which."

Some figures are used, as:

4, "where"; 5, "that the"; 7, "that is." These figures, however, belong properly to the two-letter contractions, since they are expressed by letters—4, Fr.; 5, Fv.; 7, Sv.

The two-letter contractions, of which there are upward of 400, often indicate a group of words, and must be memorized by the operator. Among them are:

Cj. "Coroner's jury"; "Fb. "of the bill"; Gx, "great excitement"; Ha, "has had"; Px, "pounds sterling"; Qp, "on the part of"; Tf, "the following"; Xb, "exorbitant"; Ys, "yesterday," etc., etc.

The three-letter contractions are quite as numerous, or more so, and are even more difficult to understand, though it is not a complicated code. Some of the three-letter contractions:

Hag, "in consequence of"; Gml, "gentlemen and ladies"; Dbf, "destroyed by fire"; Aco, "accommodate"; Acod, "accommodated"; Acog, "accommodating"; Accon, "accommodation."

In these cases the plan on which the system is based is well illustrated; the "ing" and "tion" endings are brought in without confusion.

By the use of the typewriter and the Phillips' Code, the speed of the average news operator has been increased about once, and the column that once came over the wire in an hour is received now in half that time. To papers having wires for news service this increase is a tremendous gain, though even now the companies base their charge for wires on the number of words sent in a given time.

Typewriters and shorthand are not yet in general use for commercial business, but the time is near when the "hustle" of American life, and the necessities of business will force these modern improvements upon the old-timers, who as yet regard them with suspicion.

Neosho, Mo., is now agitating the question of lighting the city with electric lights.

The Pacific Telephone and Telegraph Company, of San Francisco, Cal., is issuing to its patrons notices of the connection of their telephones to the metallic circuits underground, and giving several cuts descriptive of the conduit system run of circuits, etc.; it is quite novel.

The Daily Press and Electric Railway Accidents.

The number of deaths which are credited in the papers to the "deadly trolley wire" has led to an investigation of many of them. In no case has it been found that death was due to a shock from the electric current. Here are a few of the results of this investigation:

A man repairing a trolley wire carelessly placed his ladder so that it fell over with him. He struck on his head, crushing the skull and causing almost instant death. The paper facetiously remarked that he was undoubtedly killed by the wire, and was probably dead before he reached the ground.

Another case in which it is true death was caused by a car having electric motors passing over a boy. But, it was in the car house, and there was no trolley or electricity, and the boy was asleep beneath the car when one of the employés, desiring to shift it, started it with his shoulder, with the aforesaid result. Another instance of the "deadly trolley wire."

A carriage with two spirited horses collided with one of the "dangerous motor cars." This time the motor car was proved to have been standing on a siding, the carriage driver to have lost control of his horses, which, in running away, brought about the collision.

A very amusing incident is one in which the paper states that "a man walking some distance behind an electric car was struck by one of the flashes from the wheel, which is so familiar to us, and was seriously injured." On the witness stand one of the company's officers was recently asked whether he had not heard of the case of a man, insulated from the ground, who was shocked by coming in contact with a trolley wire, losing his life. The conundrum was a puzzling one on the face of it, but by writing to San Antonio, Tex., the following particulars were received, which cleared up the mystery:

The man was painting the pole and suspended his paint pot on the feeder wire. He was obliged to reach over another wire to dip his brush, and as his sleeves were rolled up, it is quite evident that his arm came in contact with the uninsulated portion of the feeders of two lines. The shock caused him to lose his balance on the pole, and he fell to the street, striking the back of his head on the corner of the curbing. The physicians agreed that this fall caused the death.

Sometimes the condemned wires have their use in spite of criticism. The writer recently met a man who had fallen off the top of a building 45 feet from the ground. His fall was broken by some electric wires spanning the street below. These, however, broke under the weight, and one of them slightly burned his leg. He rebounded from the wires to the street, breaking five ribs, his shoulder, arm, hand and leg. This man has recovered and has the full use of all members, but if he had not, the deadly wire would have been credited with another slaughter.

The killing of a poor little street gamin by an electric car was lamented by the American press to a surprising extent. The death is none the less sad when the cause is understood, and it is only fair to the electric service to state the facts. The boy was stealing a ride on one of the cars, and in trying to jump to another car fell under the wheels and was instantly killed. Who is responsible for this?—*Thomson-Houston Bulletin.*

Professor Trowbridge, in a recent magazine article, expresses the belief that a diminution of our coal supply would result in making the transmission of power from Niagara Falls to New York a success.

An electric car on the Amesbury and Merrimac line jumped the track at Pleasant Valley, Mass., one morning recently, and plunged down an embankment 20 feet high to the Merrimac river. One end went through the ice, and the car stood at an angle of 45 degrees. Nine passengers were on board. The accident was caused by the spreading of rails on a curve on a down grade.

BURIED WIRES.

TEN YEARS' HISTORY OF ELECTRICAL UNDERGROUND WORK.

The burying of electrical wires underground dates back to the time of Morse and Cooke and Wheatstone, but practically nothing had been done in this direction on a scale of any moment until the military telegraph lines of Germany and France were placed underground.

The English telegraph companies and later the English government made attempts, more or less successful, in this direction, experiencing much difficulty in maintaining these lines in satisfactory working condition for any length of time. Telegraph wires had also been laid underground in some of the larger European cities to a limited extent, in Vienna, Berlin, Antwerp and Brussels.

In 1882 a committee appointed by the legislature of the State of New York met in New York city to hear testimony and obtain information on this subject, owing to the clamor against the great number of overhead wires in the large cities of the State, more especially in New York. Much doubt and uncertainty was found to exist in the minds of the majority of the prominent electricians who testified before the committee, and the difficulties of overcoming the serious drawbacks of static induction and of maintaining a high degree of insulation were strongly set forth. That only further experiment would show the feasibility of a comprehensive underground system was the opinion of the majority of those who testified.

The Bell Company, in Boston, had, a short time previous to this, laid about a mile of conduit in which were placed telegraph and telephone wires, but sufficient time had not elapsed to properly test the working of the system, which consisted of iron pipes laid in cement, into which were drawn lead covered cables.

In October of 1882 the Edison low tension underground system, connected with the Pearl street station, in New York city, had been laid nearly a year and had given quite satisfactory results, it being of the same general character as the one now used by Edison Illuminating Company; that of iron pipes in which the conductors are set and insulated by a special compound forced in about them.

The numerous wires in the streets of Chicago, had become so objectionable that their removal was agitated vigorously, till at length the city fathers passed an ordinance requiring all telephone, telegraph, electric light, district telegraph and other companies to place their wires in the streets underground, or remove them, before May 1, 1883. Experimental work had been commenced in Chicago before this, and the Western Electric Company had built a wooden box subway for the Western Indiana Railroad, containing 20 telegraph wires laid in a special cable, lead covered.

The wires of the Postal Telegraph Company were first put underground as a whole, the Chicago Sectional Electric Underground Company doing the work. By December, 1884, there were about 500 miles of telegraph wires, in all, underground. In July, 1885, Electrical Subway Commissioners were appointed for New York city to determine upon the best system of conduits, authorize building of the same and see that in New York the law previously passed, requiring that all overhead wires be removed or placed underground before November 1, 1885, be carried out. This law applying to all cities having a population of 500,000 or over. In June, 1885, Subway Commissioners were also appointed for Brooklyn, to hold office till 1887. Philadelphia also passed an ordinance requiring that overhead wires be buried.

The New York Commissioners visited various cities where underground work was being done, to investigate the working of such subways as had been laid, and finally advertised for plans and specifications for electrical subways; of those submitted none were considered entirely satisfactory and none were adopted, but the Commission finally decided to favor the organizing of a company to lay the subways under places to be approved by them, together with the electrical companies interested. In October of that year a considerable number of fire alarm and police telegraph wires were laid underground in the Waring cable.

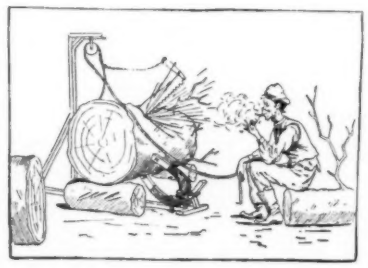
By the beginning of 1886 Washington had about three and half miles of telephone conduit laid and it was working quite satisfactorily. In Detroit there were one and a half miles of electric circuit underground.

May, 1887, saw 1868 miles of wire in subways in Chicago, with 44 miles of conduit, all the electric light wires being removed from overhead. Milwaukee, St. Paul and Minneapolis had let contracts for underground work of more or less extent.

In Brooklyn interesting experiments were early commenced by the New York and New Jersey Telephone Company using creosoted wood boxes and lead and tin covered cables.

A very large percentage of the telephone wires of Brooklyn were underground by the middle of 1887. In New York the Consolidated Telegraph and Electrical Subway Company had been formed and work had been commenced in building a comprehensive system of conduits to provide for all overhead wires; the Edison Company had 22 miles of underground conduit laid at this time. Up to January, 1892, there had been 1428 miles of subway built having a capacity for 578 miles electric light service, 721 miles telephone and telegraph service, and 121 miles Edison light service. There are 29,666 miles of telephone and telegraph wires placed in subways in New York city.

Many difficulties have been experienced in overcoming the various ills that underground work is heir to, but the results have been fairly satisfactory. As to the exact cost of maintenance, the life of cables, etc., etc., only time will tell, and a thorough summing up so as to strike an accurate balance is as yet impossible. Certainly there is no longer any doubt as to the necessity for subways in the large cities in this day of the increasing use of the electric current in every-day operations. Boston, Philadelphia, Buffalo, Detroit, Chicago, and other of the great cities of the country have placed many miles of subways to their credit in the past few years, notwithstanding the fact that the matter is still in the experimental stage, showing their characteristic spirit of enterprise and progress.



A TRIUMPH OF MODERN SCIENCE.

In Europe subway work has grown apace, especially in Germany and England.

A remarkable piece of underground engineering has been undertaken with a quite satisfactory result, the carrying of 10,000 volts electromotive force in the cables of the Grosvenor gallery station of the Ferranti Company, in London, using the alternating current. The future of these mains will be watched with much interest.

The ideal subway has not yet been evolved, but we are surely making good headway in the search.

The Edison General Electric Company's Annual Election.

The annual meeting of shareholders of the Edison General Electric Company, to hear the third annual report and to elect trustees, was held February 10. The following board of trustees was elected: C. H. Coster, Thomas A. Edison, J. H. Herrick, Samuel Insull, Edward H. Johnson, A. Marcus, Carl Schurz, Francis S. Smithers, Henry Villard, Samuel Spencer and J. Hood Wright.

The board of trustees met on February 12 at the office of Drexel, Morgan & Company, and re elected, without opposition, the old officers, as follows: President, Henry Villard; vice-president, J. H. Herrick; second vice-president, Samuel Insull; secretary, A. Marcus; treasurer and assistant secretary, E. S. Hastings; assistant treasurer, A. S. Beves; comptroller, Joseph P. Ord.

Mr. Villard presented a letter which read:

To the Board of Trustees of the Edison General Electric Company:

When I went to Europe in June, 1890, intending to be absent for a whole year, my resignation from the presidency of the company was left in your hands. It was not accepted, and, against my wish, I continued to hold the position. The rapid growth of the company's business has made it clear to me, however, for a long time past, that some one should fill the difficult place who could devote all his time to its duties, which my other occupations have not permitted me to do. You have just chosen me for a third time as the chief executive of the company. While I am sincerely grateful for your confidence, I can only accept with the distinct understanding that I shall be at liberty to retire whenever a suitable successor acceptable to you can be found, but in any event, not later than April 1 next. Yours truly, H. VILLARD.

February 12.

J. Hood Wright, of the firm of Drexel, Morgan & Company, offered a resolution thanking Mr. Villard for his services, and expressing regret at his prospective retirement. The resolution was adopted.

President Chandler at the Electric Club.

A most enjoyable meeting of the members of the New York Electric Club occurred on Friday evening, February 12. President A. B. Chandler, of the Postal Telegraph Cable Company, delivered a very interesting lecture, entitled, "My Reminiscenses of Lincoln." The meeting of the Club was in celebration of Lincoln's birthday.

President Holloway, of the Engineers' Club, who was pleasantly introduced by Mr. J. B. Edson, and Gen. James R. O'Beirne, assistant United States commissioner of immigration, also delivered interesting remarks on their personal experiences with the famous war president. Mr. Chandler's address will appear in full in the next issue of the ELECTRICAL REVIEW.

The following minute was offered by Mr. George M. Phelps, of the *Electrical Engineer*, and unanimously voted to be spread upon the records of the Club:

"The Electric Club of New York hereby expresses the profound sorrow felt by its members upon learning of the death of Mr. George Worthington.

"His genial companionship, his hearty good-will, never failing towards any, his disinterested friendship, his utter unselfishness, endeared him to all who came within the circle of his acquaintance. The memory of these traits of his, as well as of his manly independence and courage, leaves in our minds and hearts the gracious sense of past comradeship to temper the sad knowledge of our friend's departure.

"He was one of the founders of this Club, and the leading spirit in the work of building it up to usefulness and for the benefit and pleasure of its members.

"The secretary is requested to communicate this minute to the family of Mr. Worthington."

LITERARY.

"Wiring for Motor Circuits," by Thomas G. Grier, contains valuable information and working tables. The price is 50 cents.

"Electric Toy Making for Amateurs," by T. O'Conor Sloane, is one of the new books of the year. In amateur work of all kinds—mechanics, natural science, and even legerdemain or natural magic—electricity can be made to play an important part. The methods of applying it to simple constructions within the reach and scope of amateurs, constitute the theme of this work. Instructions are also given for making batteries, magnets, motors, miscellaneous toys and dynamos. We will send the book, postage prepaid, on receipt of its price, $1.

"Heroes of the Telegraph," by J. Munro, published by The Religious Tract Society, London, and sent to us by Fleming H. Revell & Company, New York, sole agents, is in some respects a sequel to the "Pioneers of Electricity," by the same author. It deals with the lives and principal achievements of those distinguished men to whom we are indebted for the introduction of the electric telegraph and telephone, as well as other marvels of electric science. We will send this work, postage prepaid, to any address on receipt of its price, $1.40.

Possibilities of Electric Traction.

BY JOHN W. BEANE.

The outlook for electric railroading for the future is probably as promising as that of any branch of electric work, and new lines are so rapidly developing in this field that it is difficult to say where the limit will be found.

Electric railways have not been long in operation, the oldest in the country having been built now only about three years, and yet there are 300 street car roads using electricity for motive power, and the number proposing to make a change from horse power is so large at this time that it is quite safe to predict that the street car horse will soon be a thing of the past, 25,000 having already been emancipated, without serious opposition on their part, I imagine.

The possibilities which are opening up for further development are of an even more extended character, developments which will, doubtless, have a very deciding influence in shaping the relative subdivision of population between city and country, as well as between urban and suburban districts. The operation of that desire for congregation, inherent in the human race, has been the cause of much inconvenience and much suffering in our larger cities, but at last the boon of electric rapid transit is now every day lessening those evils and placing fresh air and comfortable homes within reasonable reach of the workshop. That this work will not stop here it is plain, for, with the high speeds attainable and the ease of manipulation, the electrically propelled train will find here a mission in distributing the population of a great city to the surrounding districts for a radius of many miles, a feat impossible by the use of steam, owing to the expense of operation and the costly roadbed to maintain.

Take, for example, a city like Brooklyn. A distance of four to five miles will carry us outside of the limit of thickly populated territory, and at this point the speed up to 80 or 90 miles need only be limited by the cost of roadbed construction, and, to the terminal point, an average of 60 miles per hour is not unattainable, including stops. This would bring the time of transit to the terminal point, say the Brooklyn Bridge, for a distance out of 15 miles, to within 15 minutes, thus enlarging the area of occupancy to an extent sufficient to provide homes for the many thousands now huddled together in the confines of the city of New York.

Branch lines to outlying towns, that are now at least an hour away, can easily be brought to within a half hour's run. These figures apply as well to freight transportation, and we shall, no doubt, see light lines of road extending into the country between large centers and villages in the near future, where the character and abundance of farm products will warrant the outlay.

Even trunk line railroads are now seriously considering the use of electricity and the abandonment of steam, and we find the Northern Pacific, Wisconsin Central and other important roads preparing to undertake extensive tests of this form of motive power.

The service would be of a much different character from that now in use, in that it would be performed with smaller train units, with smaller intervals of time between them; certainly a much more satisfactory and convenient method. Trains would be run oftener but with less cars per train, and the belated traveler would no longer be obliged to pass through that unpleasant task of waiting several hours for the next train. Nor would he feel obliged to bolt the matutinal repast in order to catch his morning train to town or wait an hour for the next one.

The electric railroad will prove in many ways a blessing alike to poor and rich, and will make its way into larger use much sooner than the layman now imagines; it requires but a perfecting in details arising from use under the new conditions, and the problems to be solved are not so formidable as to prove a barrier to the many bright minds attacking the new work.

Vast amounts of capital are ready to undertake the investment, and the future is fully assured.

KINDRED INTERESTS

The Chicago, St. Paul and Kansas City Railway has issued some very unique advertising matter showing two important moments in the sleeping car porter's life.

An Export Order.—The Compania Nacional de Luz Electrica, City of Mexico, Mexico, through W. Loaiza & Company, 39 South William street, New York, has purchased from the Fort Wayne Electric Company a 2,000 light compound alternating dynamo.

Alfred F. Moore, of Philadelphia, manufacturer of insulated electric wires and cables, calls attention in another place to his fine and weatherproof wire, double fine armature wire, weatherproof wire and the Bishop rubber covered wires and cables, for which latter he is agent. The popularity and excellence of these goods is well attested by the extensive business and high reputation of this firm.

The Poole Electric Company, Lynchburg, Va., is now the name of the company formerly known as the Southern Electric Company. They will keep in stock the following specialties: Economic incandescent lamps, Moore's wires and lamp cords, Zurn's dynamo and engine oils, and after April 1, Poole's arc lamps. This company is in a good position to cater to the Southern trade and should obtain its share of it.

Although there is to be no regular exhibition at the Buffalo Electric Light Convention, the Crocker-Wheeler Electric Company will have a full line of motors set up and running at the office of their Buffalo agents, Messrs. F. P. Little & Company, adjoining the Broesel House. Messrs. Otis Brothers will also have one of their celebrated pumps operated by a one-half horse-power Crocker-Wheeler perfected motor and their latest C-W automatic switch.

The Copartnership existing between the firm of Cobb, Danby & Knott, of 136 Liberty street, New York city, has been dissolved. It was found necessary to take legal action, which resulted in the retirement of Mr. Danby. Mr. Eugene Smith is the entering member, and hereafter the firm will be known as Cobb, Smith & Knott. This concern has recently secured the contract for the wiring and construction work of the Edison Illuminating Company, of Coney Island.

We have received catalogues and pamphlets from the New Process Rawhide Company, of Syracuse. They are comprehensive, covering the entire field of the production of this company's goods. This concern is prosperously engaged in the manufacture of their specialties. We are told that parties placing their first orders with competitors generally come back to the old concern. This concern's gears are being generally used all along the line of electric railroads. If any of our readers are not familiar with these goods, a trial will doubtless put them on very friendly terms.

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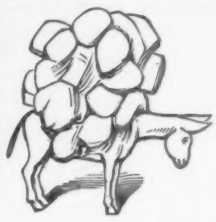

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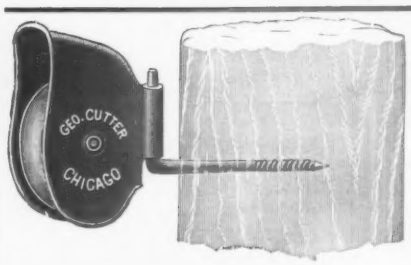

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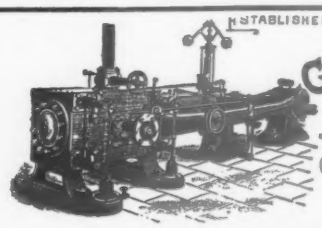

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ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON FEBRUARY 9, 1892.

468,336 Trolley wire support; Jonathan P. B. Fiske, Lynn, Mass., assignor to the Thomson-Houston Electric Co. of Connecticut.

468,388 Elevated electric conduit; Charles O. Newton, Homer, N. Y.

468,411 Carbon holder for arc lamps; Samuel P. Parmly, Chicago, Ill.

468,412 Arc light globe holder; Charles A. Pfluger, Chicago, Ill., assignor to the Standard Electric Co. of Illinois.

468,413 Arc light hanger for inside use; Charles A. Pfluger, Chicago, Ill., assignor, by direct and mesne assignments, to the Standard Electric Co. of Illinois.

468,414 Electric alarm clock; William S. Burroughs, St. Louis, Mo.

468,416 Dynamo-electric machine; George E. Dorman, Chicago, Ill., assignor to the Standard Electric Co. of Illinois.

468,426 Electrically heated smoothly cylinder; Willis Mitchell, Malden, assignor to the Butterfield-Mitchell Electric Heating Co., Boston, Mass.

468,451 Magneto-electric machine; John Hurst, New York, assignor to James Macbeth, Brooklyn, N. Y.

468,457 Machine for sewing long lengths of fabrics; Chester McNeil, Chicago, Ill., assignor to The Union Special Sewing Machine Co. of Illinois.

468,473 Repeater for electric circuits; Moses G. Crane and Frederick W. Cole, Newton, Mass.

468,474 Combined switch and switch box; Albert L. Rohrer, assignor to the Thomson-Houston Electric Co. of Connecticut.

468,487 Electric lighting system; Sylvanus L. Trippe, New York, N. Y.

468,492 Electric motor truck; Francis O. Blackwell, Boston, Mass., assignor to the Thomson-Houston Electric Co. of Connecticut.

468,497 Lightning arrester; Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Co. of Connecticut.

468,500 System for operating glow lamps by means of multiphase currents; Johannes F. H. Gorges, Berlin, Germany, assignor to Siemens & Halske, same place.

468,526 Motor gearing for electric cars; Elbert B. Phillips, Cleveland, O.

468,540 Ore separator; Henry Case, Spokane Falls, Wash., assignor of one-half to Walter Gerson, same place.

468,575 Electric railway system; William J. Ogden, Baltimore, Md.

468,585 Electric cable; William Vogler, Somerville, Mass.

468,597 Electrical indicator; Marion A. Deuel, Rochester, N. Y.

468,599 Magnetic separator; Erminio Ferraris, Turin, Italy.

468,654 Electric connector; George Gibbs, Milwaukee, Wis.

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